Draft Umatilla/Willow Subbasin Plan

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Prepared for the Northwest Power and Conservation Council

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Umatilla/Willow Subbasin Plan

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1. Executive Summary

1.1 Purpose and Process

This draft of the Umatilla/Willow subbasin plan was developed in response to the Northwest Power and Conservation Council's (Council) new review and selection process. Subbasin plans that are ultimately adopted by the Council will serve multiple purposes. Their primary purpose is to guide Bonneville Power Administration (BPA) funding of projects that protect, mitigate and enhance fish and wildlife that have been adversely impacted by the development and operation of the Columbia River hydropower system. Plans will also be used by the Council, BPA, the National Oceanic and Atmospheric Administration (NOAA) Fisheries, and the U.S. Fish and Wildlife Service (USFWS) to help meet requirements of the 2000 Federal Columbia River Power System Biological Opinion. In addition, NOAA Fisheries and USFWS will use subbasin plans as a foundation for recovery planning for threatened and endangered species.

The formal planning process for this draft began with the formation of the Umatilla/Willow Core Partnership in 2002. The Core Partnership is the lead entity for the subbasin planning process in the subbasin, and consists of representatives from six major stakeholder groups in the Umatilla/Willow subbasin: the Confederated Tribes of the Umatilla Indian Reservation (CTUIR), Morrow Soil and Water Conservation District (SWCD), Oregon Department of Fish and Wildlife (ODFW), Umatilla Basin Irrigation Districts Association (UBIDA), Umatilla Basin Watershed Council (UBWC), and Umatilla County SWCD. Members of the Core Partnership had the greatest role in the subbasin planning effort, and were responsible for taking the lead in coordinating among groups, developing the vision and biological objectives, and prioritizing subbasin strategies.

Members of a larger Stakeholder Group also played a vital role in the process by participating in reviews of early drafts and by attending five public meetings. The Stakeholder Group was composed of individuals or entities which reside in, derive their livelihood from, or are involved with business, research, or regulatory processes within the Umatilla/Willow subbasin, and members represented over 60 organizations, watershed councils, cities, counties, irrigation districts, state agencies, and federal and resource management agencies. In addition, three technical teams provided their expertise in the development and review of the plan. The General Technical Team was an interdisciplinary team that worked under the direction of the Core Partnership and was composed of specialists from various subbasin agencies and entities, as well as members of the Core Partnership. Members of this team reviewed the general information presented in the overview portion of the subbasin plan. Two more specialized teams, the Aquatic Workgroup and the Terrestrial Wildlife Workgroup, were responsible for providing the technical expertise for the development of the aquatic and terrestrial wildlife portion of the assessment and management plan. The Core Partnership hired a Project Manager to help compile, edit, and write various sections of the plan, and to facilitate technical team meetings and take the lead in compiling data contributed by agency staff. Two technical writers were also hired to work as principal authors of the plan. CTUIR was responsible for the fiscal management and contract administration involved with planning in the Umatilla/Willow subbasin.

Several sets of guidance documents were followed by subbasin planners to maximize the likelihood that the plan would meet the requirements set forth by the Council. One of these documents, the *Technical Guide for Subbasin Planners* (Council 2001), describes three necessary components of subbasin plans: the assessment, the inventory, and the management plan. The assessment forms the scientific and technical foundation for developing the subbasin management plan; it not only describes the status and limiting factors of aquatic and terrestrial wildlife species and their habitats, but it also provides relevant information about the context in which fish and wildlife management takes place, including information on the social, economic, and cultural realities of the subbasin. The inventory summarizes and synthesizes fish and wildlife protection, restoration, and artificial production activities and programs within the subbasin that have occurred within the last five years, with the goal of demonstrating 1) current management directions, 2) existing protections, and 3) current strategies implemented through specific projects. These activities are related to limiting factors identified in the assessment. Another component of the inventory is a “gap analysis”, which seeks to identify gaps between actions taken and actions needed. In combination with results from the assessment, the inventory should indicate the value and efficacy of current activities. The third component, the management plan, is described as the “heart” of the subbasin planning process (Council 2001). The primary goal of the management plan is to define the environmental and biological vision, objectives, and strategies specific to fish and wildlife in the subbasin. The planning horizon for the management plan is suggested to range from 10 to 15 years.

Another planning document that played an important role in guiding this draft of the Umatilla/Willow subbasin plan is the *Oregon Specific Guidance* (Oregon Subbasin Planning Coordination Group 2003). This document augments the guidance provided by the *Technical Guide for Subbasin Planners* (Council 2001) for Oregon subbasins. One guideline in this document that had a major effect on the organization and content of this draft plan is the stipulation that Oregon subbasin planners use a standardized outline[1]. Umatilla/Willow subbasin planners attempted to follow the outline provided by this document to the degree possible.

Once the draft Umatilla/Willow subbasin plan has been received by the Council on May 28, 2004, it will undergo an initial review by Council staff from May 29 through June 4, 2004 to determine if all the required components of the plan are included. On June 4, 2004, the plan will be sent to the Independent Scientific Review Panel (ISRP) and posted for public review on the Council’s website at http://www.nwppc.org/. At that point, three simultaneous processes will take place between June 4 and August 12, 2004. The three reviews will be: 1) a scientific review by an expanded ISRP, which will include presentations by the subbasin planners on July 21 and 22, 2004 in Pendleton, 2) an

[1] This stipulation reads as follows on p. 9 of the *Oregon Specific Guidance* “Oregon subbasin plans are required to use this outline for at least the first two levels (i.e., *[sic]* level 2.1, 4.1) for all sections except Section 3, which should include the first three levels (i.e., *[sic]* 3.1.1, 3.2.1, etc.).”

adoptability review by Council staff to determine the adequacy of the plan under the Northwest Power Act (NWPA), and 3) a general review by NOAA, BPA, USFW, the states, public, and others. The comment period ends on August 12, 2004. With additional funding available through BPA, local subbasin planners will begin editing and re-writing the plan to incorporate review comments from all contributors. These changes will be completed by November 1, 2004, when the Council staff will compile all plans into a draft Fish and Wildlife Program Amendment. On November 18, 2004, the Council will propose the Draft Amendment of Subbasin Plans, with another public comment period occurring from November 10 to mid-December, 2004. The process will end during December 2004 and January 2005, when Council staff will meet again and adopt the plans.

1.2 Summary of the Assessment

As described above, the assessment forms the scientific and technical foundation for developing the subbasin management plan; it not only describes the status and limiting factors of aquatic and terrestrial wildlife species and their habitats, but it also provides relevant information about the context in which fish and wildlife management takes place, including information on the social, economic, and cultural realities of the subbasin. The assessment in this plan is organized in two major sections. The first section is an overview section, which describes the size, location, geology, economy, land ownership, influences of human activities on the aquatic and terrestrial environment, water resources, hydrologic and ecologic trends, and the greater regional context in which the subbasin falls. The rest of the assessment describes the status of aquatic and terrestrial wildlife species and their habitats, the limiting factors that negatively impact these species inside and outside the subbasin, the desired future conditions, and the working hypotheses, which describe how actions that address limiting factors will influence focal species populations. The main points of each of these sections are outlined below.

1.2.1 Location, Size, Geology, and Climate

The Umatilla/Willow subbasin is a 3,714 square mile area in northeastern Oregon and occurs primarily in Umatilla and Morrow Counties, with a small portion located in Union County. The Umatilla/Willow subbasin is composed of four drainages: the Umatilla subbasin, the Willow Creek subbasin, the Six-Mile Canyon drainage, and the Juniper Canyon drainage. The mainstem Umatilla River is 89 miles long and the river and its tributaries drain an area of nearly 2,290 square miles. Willow Creek is 79 miles long and drains an area of about 880 square miles. The Six-Mile Canyon area, which contains intermittent streams that rarely drain into the Columbia River, is 472 square miles. The mainstem of Juniper Canyon Creek is 19 miles long and drains 72 square miles.

The Umatilla/Willow subbasin consists of two geologic provinces: the Blue Mountains and the lower basin. The Umatilla River and its tributaries begin in the Blue Mountains, which are characterized by deeply incised upland surfaces and a ramp-like slope called the Blue Mountain slope or foothills. The flat-topped ridges and steep stair-stepped valley walls of the Blue Mountains were formed by thousands of feet of Miocene basalt flows. Streams leaving the canyons of the Blue Mountains cross a wide expanse of plains and terraces making up the lower basin, which is comprised of tertiary and quaternary loess, alluvium, glacio-fluvial, and lacustrine sediment deposits which mantle the Columbia River basalts across much of the lower elevations.

The entire Umatilla/Willow subbasin falls within Oregon's North Central Climatic Zone (Zone 6). The major influence on the regional climate is the Cascade Mountains to the west, which form a barrier against warm moist fronts from the Pacific Ocean. The Columbia Gorge provides a break in the curtain of the Cascade Mountains and occasionally allows moisture laden marine air to penetrate into the northern Blue Mountains. This induces light to moderate precipitation (depending on elevation), and results in vegetation common to the west slopes of the Cascades. The subbasin experiences strong seasonal fluctuations in both temperature and precipitation. In the summer the subbasin experiences a continental climate with warm days, cool nights and little precipitation. Winters are much colder, with average temperatures often only slightly above freezing. Precipitation also changes dramatically with the seasons, with most precipitation in the subbasin falling during the fall, winter and spring.

1.2.2 Land Cover and Use, Population, and Land Ownership

General types of land cover found in the Umatilla/Willow subbasin, in order of prevalence, include agricultural areas, shrub-steppe, grasslands, forested communities, urban areas, and riparian areas and other wetlands. Forested communities are associated with higher elevations and agricultural lands, grassland, and shrub-steppe are more common at lower elevations. The majority of land in Umatilla and Morrow Counties is used for agricultural purposes, as defined by the proportion of the total area designated as cropland, pasture, and rangeland. Cropland, both dryland and irrigated, comprise about 39% of the Umatilla/Willow subbasin. Approximately 73% of the cropland in the subbasin is dryland and 27% is irrigated. Rangeland and range-forest transition areas account for 42% of land cover, forest accounts for approximately 14%, and urban and developed areas account for approximately 1%.

Approximately 70,548 people lived in Umatilla County in 2000, resulting in a density of 21.9 people per square mile. The majority of these people (51.2%) live in rural areas and in towns of less than 2,000 people; the remaining population lives in Pendleton, Hermiston, and Umatilla, which are all found along the mainstem of the Umatilla River. Morrow County had a population of 10,995 in 2000, resulting in a density of only 5.4 people per square mile. Only one town in Morrow County, Boardman, has a population larger than 2000. The total resident Native American population on or near the Umatilla Indian Reservation was more than 2,400 in 1998 (including Native Americans enrolled with other Tribes). CTUIR membership numbered 2,140 members living on and off Reservation lands. The Reservation is also home to about 1,700 non-Native Americans.

The economies of Umatilla/Willow subbasin have risen steadily from 1990 to 2000. Major components of the economy include agriculture, government sources, manufacturing, service industries, and wildland recreation. Agriculture, in particular, plays a major role in the economy, both directly and through its influence on other industries such as transportation, manufacturing, and government. In 2001, Umatilla

County farmers and ranchers employed 5,750 workers involved in the production of agricultural commodities, and the total value of agriculture to the economy of Umatilla County was estimated at $685 million in 2001. In 2003, Umatilla County ranked fifth in the state in agricultural commodity sales at $200 million and Morrow County ranked eighth at $180 million. Wheat, irrigated crops, and livestock are the most important agricultural products of the subbasin.

The majority of land in the Umatilla/Willow subbasin is privately owned. Approximately 11% of the drainage is managed by federal agencies, including the United States Forest Service (USFS), which manages over 70% of federally owned lands. Other landowners in the subbasin include the State of Oregon, counties, cities, and the CTUIR.

1.2.3 Human Influences on the Aquatic and Terrestrial Environment

Humans exert both positive and negative effects on the aquatic and terrestrial environment in the subbasin. Some of the most prevalent human influences in the subbasin are associated with agriculture, exotic weed introduction, forest practices, livestock grazing, transportation, urbanization, and water development. All of these human activities, except for exotic weed introduction, provide widespread and well-recognized benefits to Oregon's citizens, communities, and economies. However, because of the scope of this plan, these activities are discussed in terms of their influence on aquatic and terrestrial environments that are important to fish and wildlife in the subbasin. Negative impacts of these activities include stream channelization, reduced instream water volume, high water temperatures, riparian vegetation loss, increased erosion and sedimentation into streams, and land conversion and degradation. The ecological effect of these negative impacts include increased flood frequency, reduced water quality, separation of stream channels from floodplains, loss of exchanges between the hyporheic zone and river flow, and loss and degradation of habitat for aquatic and terrestrial wildlife species. Although the Umatilla/Willow subbasin is not unique in experiencing negative effects on fish and wildlife habitat associated with human activity, it is unique in the sense that stakeholders with different interests have a strong history in working together to solve the most pressing of these problems. Progress has been substantial, and has resulted in major improvements, especially with respect to improving water quality and quantity issues facing anadromous fish.

1.2.4 Existing Water Resources

Two major river systems occur in the subbasin: the Umatilla River and Willow Creek. The Umatilla River headwaters are in the Blue Mountains, where the North and South Fork join to form the mainstem, an 89 mile reach of river that flows through a series of broad valleys that drain low rolling lands. The mainstem Umatilla River has eight main tributaries: the North and South Forks of the Umatilla River and Meacham Creek in the upper subbasin; Wildhorse, Tutuilla, McKay and Birch Creeks in the mid subbasin; and Butter Creek in the lower subbasin. Like the Umatilla River, the headwaters of Willow Creek and Juniper Canyon Creek are also found in the Blue Mountains. The primary tributaries of Willow Creek are Eightmile Creek and Rhea Creek, and the primary tributaries of Juniper Canyon Creek are the North and South Forks of Juniper Canyon.

Flows in the Umatilla/Willow subbasin are characterized by high peaks during the early spring and often extremely low flows in the summer. The patterns in flow observed in the Umatilla/Willow subbasin are the result of snow melt and rain in late winter and early spring which cause peaks in flow. Water runoff peaks in April, while the lowest flows, or baseflows, generally occur in September.

Another significant component of the subbasin's hydrology that is often overlooked is the exchange of ground and surface water in rivers. In alluvial rivers such as the Umatilla River, ground- and surface-waters circulate continuously and bidirectionally between the river channel and alluvial aquifer, which underlies the river and flood plain. This bidirectional exchange creates a shallow ground-water flow network known as the hyporheic zone. Because hyporheic flow circulates continuously, the potential for ground-water to influence stream temperature may be much higher in streams and rivers with substantial hyporheic flow. Research on the exchange of ground and surface water on the Umatilla River has shown that 1) high rates of hyporheic exchange are associated with cooler stream temperatures, and 2) channel engineering in the subbasin has resulted in substantially simplified channel and flood-plain morphology, and modeled rates of hyporheic exchange are noticeably reduced from similar areas where dredging and diking have not occurred. Therefore, reduced hyporheic exchange associated with channel engineering provides a likely mechanism to explain the tendency for the river to warm rapidly as it flows through engineered reaches.

Water quality issues in the subbasin are being actively addressed. A Total Maximum Daily Load (TMDL) and Water Quality Management Plan (WQMP) were completed for the Umatilla subbasin in 2001. A TMDL is currently being developed for the Willow Creek subbasin and a WQMP was recently completed. In addition, the CTUIR have requested to be treated as a state and have coordinated with the Environmental Protection Agency (EPA) to develop water quality standards pertaining specifically to reservation lands.

Throughout the Umatilla/Willow subbasin, three important beneficial uses -- domestic water supply, salmonid life cycles, and water contact recreation -- are not fully supported as a result of water quality impairments. Water quality impairments arise from a variety of variables and have resulted in many reaches in the Umatilla/Willow subbasin listed in accord with Section 303(d) of the Clean Water Act of 1972 as being water quality-limited water bodies. The most important of these variables are water temperature, sedimentation, and habitat modification. Other variables include turbidity, pH, nitrates, ammonia, bacteria, aquatic weeds and algae, and flow modification.

The current condition of the riparian vegetation varies considerably throughout the Umatilla/Willow subbasin. The majority of the riparian vegetation in the upper tributaries is composed of narrow bands of hardwood and conifer species, while galleries of large mature cottonwoods exist in some areas of CTUIR land as well as in a few areas along the mainstem Umatilla River below Pendleton. Lower mainstem and tributary reaches have riparian vegetation types primarily composed of shrubs and grasses, with some scattered hardwood trees. In some cases where crop cultivation extends to the stream banks or where grazing pressure is high, woody or shade-producing riparian vegetation is sparse. Much of the lower mainstem is diked, and trees are actively prevented from growing on the dikes. Riparian vegetation on the mainstem Umatilla River and many tributaries is in poor condition, with approximately 70% of 422 miles inventoried identified as needing riparian improvements. Losses of riparian vegetation are particularly high in the lower subbasin; one study estimated those losses at greater than 95% as compared to pre-settlement conditions (c. 1850).

Wetlands are another important resource in the Umatilla/Willow subbasin. Based on a limited analysis conducted by the CTUIR, wetland losses in the upper Umatilla River range from 30 to 35%, while wetland losses in the Umatilla/Echo Meadows area are estimated to be as high as 90%. Three important wetland areas remain in the Umatilla subbasin: Minthorn Springs on the Umatilla Indian Reservation, a braided portion of the Umatilla River downstream of Pendleton, and the Echo/Umatilla Meadows complex.

1.2.5 Effects of Climate and Humans on Hydrologic and Ecologic Trends

Effects of Climate

Hydrology and ecology are influenced to a great degree by a region's climate. Thus, year-to-year variation in climate can result in year-to-year variability in the hydrologic regime and fish and wildlife populations. However, no obvious trends in climate over the last 100 years are evident in the subbasin, suggesting the absence of climate-induced trends in either hydrology or ecology in the subbasin. However, the ecology of the subbasin is likely influenced by trends in climate outside of the subbasin. An important weather pattern in the Pacific Northwest that appears to have a strong influence on salmon survival in the ocean is the Pacific Decadal Oscillation (PDO). The PDO pattern is of a period of cool, wet years followed by a period of warm, dry years. PDO patterns can influence the abundances of adult salmon and steelhead returning to the Columbia River and to the Umatilla/Willow subbasin.

Effect of Human Activities - Agriculture

Hydrology and ecology have also been influenced by human activities through time. Intensive dryland agriculture began in the subbasin in the 1880s, and resulted in large amounts of native grassland being converted to dry cropland. The completion of several irrigation systems in the early 20th century allowed for the conversion of arid areas in the lower basin into irrigated croplands. Since the advent of modern irrigation systems, approximately 480,000 acres of land have been developed for crop production. Other than through water development, trends in agriculture have had two important impacts on the subbasin's fish and wildlife resources: the conversion of native grasslands and shrub-steppe plant communities to croplands and an increase of erosion and sediment input into streams. Agricultural impacts on wildlife have not all been negative, however. Agricultural areas support many small birds and mammals, important predators such as coyotes and red-tailed hawks, and game species such as Ring-necked Pheasants and Wild Turkey. In addition, negative impacts of agriculture on fish and wildlife resources in the subbasin have been mitigated to a degree by conservation incentive programs, such as the Conservation Reserve Program (CRP) and Direct Seeding Program. As of 2003, the

Umatilla/Willow subbasin had more than 200,000 acres enrolled in CRP and more than 50,000 acres in which growers used direct seeding.

Effect of Human Activities – Exotic Weeds
The ecology of the subbasin has also been affected by the spread of exotic weeds. Problems with exotic weeds were identified as early as 1902 and have increased dramatically in recent times. The spread of exotic weeds not only reduces the abundance and diversity of native vegetation, but can also negatively affect fish and terrestrial wildlife and natural ecological processes, such as fire regimes in shrub-steppe habitats.

Effect of Human Activities – Forestry Practices
Hydrological and ecological trends in the subbasin have also been impacted by forestry practices. Although commercial forestry began in the Umatilla/Willow subbasin in the 1920s, large amounts of timber were not cut until the 1950s. Data on harvest rates indicate that harvest peaked in the subbasin in the 1970s and declined substantially by the 1990s, although extensive logging still occurs in the subbasin, especially on private property. Fire suppression has also had a major effect on the structure and composition of the forest vegetation within the subbasin. The result of these vegetation changes has been an increase in fuel loads to the extent that forested areas are at significantly higher risk of experiencing stand replacing wildfires as compared to historic conditions.

Effect of Human Activities – Livestock Grazing
Livestock grazing has also influenced the hydrology and ecology of the subbasin since pre-European settlement times. The local tribes, particularly the Cayuse, owned large numbers of horses, which likely impacted the native grasses of the region. White settlers also raised livestock and livestock grazing continues to be an economically important activity in the subbasin. Although sheep were originally the most common livestock raised, by the late 1950s cattle had become the predominant livestock. The total number of livestock in Umatilla and Morrow counties was quite large in the early 1900s, often totaling over 250,000 head of sheep. However, in the early 1930s the numbers began to decline and currently there is approximately 90,000 head of livestock in each county. Negative effects of improper grazing practices include 1) the reduction of the total amount of native vegetation, 2) replacement of native vegetation with plants of low forage value and/or exotic species and 3) reduction of surface cover, resulting in increased surface and wind erosion. These effects can negatively impact both aquatic and terrestrial wildlife species.

Effect of Human Activities – Settlement and Urbanization
Trends in settlement and urbanization have also affected the hydrology and ecology of the subbasin. The first human inhabitants of the Umatilla/Willow subbasin were Native Americans of the Walla Walla, Cayuse, and Umatilla Indian Tribes. Historically, Native-Americans relied heavily on hunting, fishing, and gathering. This lifestyle changed as large numbers of white settlers moved into the Umatilla/Willow subbasin in the mid 1800s. Conflict arose when the federal government gave Native American lands in the Oregon Territory to settlers. This conflict ended, for the most part, with the Treaty of 1855. Under the Treaty, the Tribes ceded 6.4 million acres of their lands in northeast

Oregon and southeast Washington to the United States and reserved rights for fishing, hunting, gathering foods and medicines, and pasturing livestock. The Tribes also reserved 510,000 acres on which to live. Today, there are over 2,400 tribal members, and the lands of the CTUIR encompass 172,000 acres. Approximately 75,500 acres of the reservation are privately owned.

The population of the Umatilla/Willow subbasin has grown steadily over the last 100 years, with much of the growth occurring in the three largest cities, all of which were established before 1910. The subbasin is expected to continue to grow by about 10,000 people in the next 10 years. Urbanization has affected about 1% of the land in the Umatilla/Willow subbasin, and the impacts of urbanization include effects on water flow and water quality, and the construction of dikes, levees, and rip-rapped banks. Several efforts are underway in the Umatilla/Willow subbasin to reduce negative impacts of urbanization on stream water quality and water flow conditions, including hazardous materials training for public works employees and water supply development programs being developed and implemented by the City of Pendleton.

Effect of Human Activities – Transportation Corridors

The earliest routes of transportation in northeastern Oregon were formed by Native Americans of the Columbia Plateau, as they traded goods with tribes west of the Cascades and east of the Bitteroot Mountains. Later, early white settlers established major transportation routes in the Umatilla/Willow subbasin, including the Oregon Trail, as they moved to the western United States in wagon trains. Estimates from 1842 to 1849 indicate a total of 12,287 immigrants moved through CTUIR tribal homelands during that time. The movement of large numbers of settlers into the area had a devastating effect on Native Americans. Diseases introduced by settlers killed up to 50% of area Native Americans; resources, including fish and wildlife, were degraded and depleted; and, eventually, most tribal lands were lost.

Further development of transportation corridors in the Umatilla/Willow subbasin continued with the coming of the railroad in 1881, which opened the area to the development of dryland wheat farming. Many past and current railroad routes follow the Umatilla River and its tributaries and Willow Creek. Roads and highways have also continued to increase in the Umatilla/Willow subbasin. Although first used by horse drawn vehicles, roads became more common with the widespread use of the automobile, and with the development of urban areas, such as the cities of Pendleton, Umatilla, and Hermiston. In addition, the timbering industry resulted in a high density of roads in many of the forested areas in the subbasin. Both paved and gravel roads are often constructed along waterways in the Umatilla and Willow Creek subbasin.

Transportation corridors can significantly impact hydrology and ecology by increasing 1) the loss of riparian vegetation, 2) stream water temperatures, 3) surface water run-off into stream channels, and 4) flashiness in stream flow.

Effects of Human Activity – Water Development
Water development for irrigation has had a large impact on both the hydrology and ecology of the Umatilla/Willow subbasin. Irrigated agriculture is served by six diversion dams found in the lower Umatilla River and two reservoirs, Cold Springs and McKay Reservoirs. In Umatilla County, the first large irrigation canal, the Hinkle Ditch, was constructed in 1903. In 1905, the Secretary of the Interior authorized the Umatilla Basin Project, for the purpose of irrigating 60,000 acres of land and building a reservoir. By 1916 three major irrigation systems, including diversion dams and canals, and one reservoir, Cold Springs, had been completed as part of the project. In 1927, a second reservoir, McKay Reservoir on McKay Creek, was completed.

During the same period, private irrigation ventures were started. These included a project by the Furnish Ditch Company, which began in 1903. By 1907 the company had built a diversion dam east of the town of Echo, which is currently operated by the Stanfield Irrigation District. The other private venture, Western Land Irrigation Company, was started in the 1890s. It is currently the Westland Irrigation District and operates the Westland Diversion Dam.

These irrigation diversion projects and McKay Reservoir have had important impacts on the hydrology of the Umatilla subbasin. During the summer months, discharge in the lower Umatilla River decreases with water withdrawals and shows slight increases with irrigation return water. Water is released from McKay Reservoir during peak irrigation periods. The impact of storage of water in McKay Reservoir and releases of water during the summer months is to lower mean monthly instream flows during the winter when water is stored and increase flows during the summer when stored water is used for irrigation.

The hydrology of Willow Creek is also greatly influenced by irrigated agriculture as well as the construction of the Willow Creek Dam. Irrigated agriculture began in the late part of the 19th century. Currently, total annual flows are reduced by approximately 23% due to extensive irrigation withdrawals. The Willow Creek Dam was constructed mainly as a flood control structure, and not for irrigation (although a permit issued by OWRD does allow the storage of 3,500 acre-feet for irrigation purposes). As such, its influence on downstream hydrology is different than diversions built for irrigation purposes. This hydrology is characterized by no natural floods, a regular fall peak in flow during reservoir draw-down, and constant high winter and spring flows.

In the Umatilla River, the dewatering of reaches and the creation of passage barriers that were necessary for irrigation activities resulted in the extirpation of Chinook and coho salmon stocks and the endangerment of the steelhead stock in the 1920s. In response to the need for continued irrigation and the desire to restore steelhead and salmon populations a unique coalition formed in the 1980s between the CTUIR and local irrigators. With the help of the BOR, BPA, Oregon Water Resources Department (OWRD), and ODFW, this coalition has made substantial progress in recovering salmon populations in the subbasin without harming irrigated agriculture. The coalition led to the development of the Umatilla Basin Project Act, which was passed by Congress on October 28, 1988.

The Act allows irrigators to exchange Umatilla River water for Columbia River water. This allows water historically appropriated for irrigation to remain in the Umatilla River during times when flows are critical for steelhead and salmon. Two phases of the Act have been completed and a third phase has been proposed. Phase I of the project involves pumping water (up to 140 cfs) from the Columbia River into the West Extension Irrigation District system to offset diversion of Umatilla River water when flows in that river drop below target values. Phase II involves exchanging up to 240 cfs of Umatilla River and McKay Reservoir water for Columbia River water for use by the Stanfield and Hermiston Irrigation Districts. This results in water that had historically been diverted from live flow and from McKay Reservoir releases being retained for instream uses. As a result of Phase II, approximately one half of the storage in McKay Reservoir is now used to maintain instream flow in the Umatilla River below McKay Creek.

While the water exchanges associated with the Umatilla Basin Project do not increase flows year-round, they do increase flows during critical times for salmon and steelhead adult returns and juvenile outmigration. In addition, releases of water from McKay Reservoir during summer generally positively impact temperatures of reaches of the Umatilla River below the McKay Creek confluence. However, McKay Reservoir releases for fish are not continuous during the summer, and water temperatures in the river can become extreme at times. In addition, warmer epilimnetic waters can be discharged upon the depletion of the hypolimnion and can contribute to unsuitable habitat conditions for salmonids.

While these phases have helped the recovery of the steelhead population and assisted the reintroduction of Chinook and coho populations in the Umatilla River, irrigation still removes approximately half of the instream flows during the summer months. The proposed Phase III of the Umatilla Basin Project would involve a complete exchange of water in the Umatilla River used by Westland Irrigation District with Columbia River. This proposed exchange of water coupled with already completed Phases I and II would allow a substantial portion of the Umatilla River surface water to remain instream.

Another negative effect of the construction of diversion dams was problems with passage, entrainment, and injuries to fish at points of diversion. In an effort to address these problems, outdated juvenile and adult fish passage facilities were reconstructed between 1988 and 1994 at five major irrigation dams on the lower Umatilla River.

In addition, water development might also have had an important impact on non-salmonid fish species in the subbasin. Summer fish communities in the lower Umatilla mainstem include exotics whose abundance in the river may be aided by low discharge and high temperatures. These species include smallmouth bass, largemouth bass, carp, bluegill, yellow perch, black crappie, channel catfish, and mosquitofish. It is unclear what impact these exotic fish have on the ecology of the river system including the abundance of native species.

Finally, while little work exists on the impacts of water development on wildlife, waterfowl numbers have increased recently in the subbasin. While this has been attributed to the construction of the John Day and McNary dams and their reservoirs, the Cold Springs and McKay Reservoirs most likely contribute to the increase in these species within the Umatilla/Willow subbasin as well.

1.2.6 Regional Context

The Umatilla/Willow subbasin is located near the center of the Columbia basin and accounts for approximately 1.7% of the total area of the Columbia basin in the United States. The Umatilla River flows into the Columbia River at RM 289 and Willow Creek enters at RM 253. Three major Columbia River dams (the John Day, The Dalles, and Bonneville dams) are downstream of these confluences.

The Umatilla/Willow subbasin is one of ten subbasins grouped in the Columbian Plateau ecological province, which is the largest of the 11 ecological provinces. Because subbasins in the Columbia Plateau province are grouped together based on similarities in climate and geology, the Umatilla/Willow subbasin and most other subbasins in the province were historically dominated by interior grasslands and/or shrub-steppe habitats, are currently dominated by agricultural lands, have low human population densities, and have large portions of land in private ownership. The importance of agriculture and the arid nature of the area also results in a problem common in most other subbasins in the province: water is over-appropriated and is required for multiple, sometimes competing purposes. Like most other subbasins in the province wildland recreation, including fishing, hunting, boating, and hiking, is also an important component of the economy and culture of the Umatilla/Willow subbasin.

The fish and wildlife of the Umatilla/Willow subbasin are also related to other subbasins in the province. For example, bull trout of the Walla Walla, John Day, and Umatilla/Willow subbasins belong to the same gene conservation group. In addition, the Umatilla/Willow, John Day, Yakima, and Walla Walla subbasins share the same Middle Columbia River Steelhead evolutionarily significant unit (ESU). Many of the terrestrial wildlife species found in the Umatilla/Willow subbasin are also found in other subbasins in the province, with mobile species often moving between subbasins in the province. Fish and wildlife in the Umatilla/Willow subbasin face many of the same problems that threaten species in other subbasins of the province, both from within and outside of the subbasin.

Although the Umatilla/Willow subbasin is similar in many ways with the other subbasins in the province, it is unique in other ways. Perhaps most notable is the way in which stakeholders in the Umatilla/Willow subbasin with different interests have worked together to improve fish habitat in the Umatilla River through the Umatilla Basin Project, as describe above. The subbasin is also unique in other ways related to water resources and the presence of salmonid species. Extirpated Chinook and coho salmon have been reintroduced to the subbasin, and their production, as well as steelhead production, has been increased through hatchery supplementation. Natural production of steelhead is increasing as well; returns of Middle Columbia River ESU natural summer steelhead adults are increasing more rapidly in the Umatilla River than in the Walla Walla or John Day subbasins. The Umatilla/Willow subbasin also provides important habitat for many salmonids. Although the subbasin contains only about 1.5% of all the river miles in the U.S. portion of the Columbia basin and 6% of all the river miles in the Columbia Plateau province, it provides a disproportionate amount of salmonid habitat.

The terrestrial environment in the Umatilla/Willow subbasin is also unique in that it contains some of the largest remaining tracts of shrub-steppe habitat in the Columbia Plateau in Oregon.

Environmental conditions external to the Umatilla/Willow subbasin impact both fish and wildlife species in the subbasin. Anadromous fish leaving the subbasin as juveniles and returning as adults are affected by multiple aspects of the aquatic environments they encounter in that journey, including three major dams on the Columbia River, and variable estuary and ocean conditions. Passage barriers, poor water quality, flow issues, and predation are some of the obstacles facing these fish outside the subbasin. In addition, salmon and steelhead abundances are influenced strongly by ocean conditions including the PDO. Likewise, highly mobile terrestrial wildlife species are also affected by out-of-subbasin conditions. These may range from problems such as loss of habitat connectivity in adjacent subbasins to deforestation of wintering habitat in South America.

1.2.7 Fish, Wildlife, Plants, and Invertebrates of Ecological Importance

The Umatilla/Willow subbasin is home to a multitude of fish, wildlife, plants, and invertebrates of ecological importance and/or conservation concern. Species of conservation concern in the subbasin include two fish and five terrestrial wildlife species that are currently listed as threatened or endangered by Oregon and/or the federal government. In addition, three wildlife species in the subbasin are federal candidate species and three plant species in the subbasin are state candidate species. Three fish species, 22 wildlife species, and five plant species also fall into the USFWS “species of concern” category and two fish species and 10 wildlife species in the subbasin are listed as sensitive species by the USFS. USFS has also established a list of 30 sensitive plant species found in the Umatilla National Forest. At the state level, the subbasin has three fish species and 43 wildlife species found on Oregon’s sensitive species list, including 15 wildlife species that are considered “critical sensitive species”. Other important species in the subbasin include species that are rare or significant to the local area, Partner in Flight species, critically linked species, functional specialists, and managed game species.

1.2.8 Aquatic Assessment

Focal Species and Rationale

Five aquatic focal species were selected for the subbasin: bull trout, summer steelhead/redband trout, spring Chinook, fall Chinook, and coho. The focal species are used to develop management strategies that should enhance the quality of the environment for all aquatic species. Focal species were selected based on three criteria: 1) the degree to which they have special ecological, cultural or legal status, 2) the extent to which they "represent" certain habitat types and the aquatic communities found in those habitats and 3) the availability of adequate knowledge of the species' biology in the subbasin for use in the Ecosystem Diagnosis and Treatment Model (EDT) and the Qualitative Habitat Assessment Model (QHA). Steelhead and bull trout are both federally listed as threatened species. Redband trout were chosen with steelhead because current genetic information suggests there is little difference between the two and redband trout are found in Willow Creek and its tributaries, whereas, all anadromous species have been extirpated from that area. Spring Chinook and coho were selected as focal species because each species has unique distributions, habitat requirements and life history characteristics. Fall Chinook were selected as a focal species based primarily on their cultural, social, and political importance in the subbasin.

In addition, two "taxa of interest" were identified because of their cultural and ecological importance in the subbasin. These taxa are mussels and Pacific lamprey.

Status of focal species population and distributions
Two populations of bull trout are found in the subbasin. One population inhabits the north and south forks of the Umatilla River; however, the important center for this population is a section of the North Fork where the highest density of spawning occurs. The other population inhabits North Fork Meacham Creek. Adult abundance in the North Fork Umatilla has been estimated over the past decade using redd counts. The number of spawning adults has averaged 165 over this period with a general increasing trend. Despite this, the population is considered "of special concern" regarding extinction by the ODFW. The population in Meacham Creek is in worse shape and is considered "at high risk" of extinction, mainly because the habitat is of lower quality and the population size is smaller. Little information exists regarding the historical distribution of bull trout in the subbasin. Recent sightings of bull trout in the mid- and lower Umatilla River and in lower McKay Creek suggest that, in addition to the current distribution, these reaches might have had important historical use and are used only infrequently now and are not considered viable bull trout habitat as a result of degraded stream conditions. Because of their threatened status, there is no current harvest of bull trout; however, before 1994 there was a limited amount of tribal and sport harvest in the subbasin.

An annual average of 2,412 returning adult steelhead entered the subbasin between 1988 and 2003, with a peak of 5,520 adults returning in 2002. Naturally produced adults have averaged 68.9% of the return during this time. Estimates of productivity based on female escapement and number of redds suggests that there has been a trend of increasing productivity in the subbasin from the early 1990s to 2002. However, estimates of the number or returning adults per spawner do not support this trend. These estimates indicate that the population has been below replacement (i.e., the number of returning adults is less than the number of spawners) for most of the years during this same period with no obvious increasing trend. The current spawning distribution of steelhead is much below that of the estimated historic distribution. Spawning currently occurs in the upper mainstem, North and South Forks, Meacham Creek, and the upper Birch Creek watershed. Historic spawning occurred throughout the subbasin and included the majority of the mainstem and McKay, Butter, and Wildhorse Creeks. Causes of this reduced range include increased sediment load, high water temperatures, and habitat loss mainly through loss of riparian vegetation. The steelhead population is supplemented with hatchery stock. This supplementation began in 1967 with Skamania and Oxbow stocks, but has been from endemic stocks every year since 1975. Returning hatchery adults form an important opportunity for both tribal and sports harvest. Between the years 1993 and 2001 from 8 to 20% of the hatchery returns have been harvested by both tribal and sports fishermen, with an increasing trend from 1998 to 2001.

Spring Chinook were extirpated from the subbasin in the 1920s and were reintroduced to the Umatilla River in 1986 with Carson stock. Adult returns to the subbasin have been counted since 1988. The average number of adult returns between 1988 and 2002 was 1,968 with an increasing trend from 1999 to 2002. In 1996 the first naturally produced adults returned to the Umatilla River and they have returned in small numbers (from 22 to 348) since then. Hatchery returns form the great bulk of the returns (84 to 98.8%). The productivity of the spring Chinook population appears to be increasing over the years 1991 to 2002 based on the number of redds and the number of spawned out female carcasses. However, during the period from 1992 to 1997 the population was below replacement every year except one (1992) based on the number of adults returning per spawner. As with steelhead, the current spawning distribution is much smaller than the estimated historic distribution for the same reasons. The current distribution is limited to the upper mainstem, the North Fork Umatilla, and Meacham Creek. The historic distribution included the middle mainstem and McKay, Birch, and Butter Creeks. In 1986 the population was reintroduced with Carson Stock from the Little White Salmon Hatchery. Beginning in 1998 the majority of the broodstock has come from adults returning to the Umatilla River. As a result of the hatchery program, returns of spring Chinook have been large enough to support a sport and tribal harvest in 10 of the last 13 years. An average of 13.4% of the returns have been harvested by sport and tribal fisheries during this period.

Fall Chinook were reintroduced into the Umatilla River in 1982 with Spring Creek tule stock (in 1982) and upriver bright stock (1983 on). However, the first adults did not return to the river until 1988. Between 1988 and 2001 the average number of adults returning was 493; jacks also make up an important part of the return and their numbers have averaged 275 during the same period. A strong increase in the number of adults returning to the Umatilla River was evident from 1998 to 2001. In 1995 the first naturally produced adults returned to the Umatilla River. The numbers of naturally produced adults has been very small and hatchery returns represent the great portion of total returns. Productivity of fall Chinook in the subbasin is very low based both on female spawning escapement and the number of returning adults per spawner. To supplement natural production, annual outplanting of several hundred adult females from Priest Rapids and Ringold Springs Hatcheries started in 1996. The historic distribution of fall Chinook in the subbasin is unclear because traditionally fall and spring Chinook were recognized as one species and it is unknown where divisions between their spawning habitats occurred. Because of the low number of returning adults there is no tribal or sports harvest of adults; however, there is a small harvest of returning jacks.

Coho were reintroduced into the subassin in 1966 with Tanner Creek stock. The hatchery program stopped in 1969 and did not pick up again until 1987 (using the same stock). Adult returns to the Umatilla River have been enumerated since 1988. Between 1988 and 2003 the number of adults returning has varied widely, from 356 (in 1992) to 22,792 (in 2001) and averaged 3,669 adults. Jack numbers have also varied during this time from 16 (in 1993) to 1,276 (in 2000) and averaged 361 jacks. As with steelhead and spring Chinook the number of adults returning shows an increasing trend from 1998 on. For all species, this increasing trend might reflect positive changes in ocean conditions resulting from a PDO phase shift. Productivity, based on spawning escapement, has also seen an increase from 1998 to 2003. It is difficult to compare the current vs. the historic distribution of coho in the subbasin because the historic distribution is unclear. Records specifically stating that coho were in the Umatilla River or Willow Creek are not available. The coho hatchery program supports a sports fishery and from the years 1992 to 2001 an average number of 240 adults and 62 jacks were harvested, representing 5% of the adult run and 33% of the jack run.

Determination of Limiting Factors and Priority Areas

To determine the limiting factors and priority areas for restoration and protection for the natural production of each focal species, two modeling methods were used. EDT was used for the anadromous species and QHA was used for bull trout in the Umatilla River subbasin and redband trout in the Willow Creek subbasin. Both modeling approaches identify limiting factors and prioritize geographic areas for restoration and protection. Results of the models revealed that the primary limiting factors were sediment load, high water temperatures, habitat complexity, and habitat quantity. These factors can be addressed by improvements to specific attributes of the environment through restoration techniques.

The EDT results presented in this draft of the plan represent only a preliminary attempt at using EDT for the Umatilla subbasin. Several problems were encountered with how the model had been developed for the subbasin at a time when it was too late to change the model before the May 28, 2004 deadline. Therefore, the results presented here should be viewed as preliminary and there are plans to update and finalize the model during the summer of 2004.

EDT modeling was also used to examine the impact of three restoration scenarios on anadromous focal species populations:

1) Habitat restoration of the top priority geographic areas singly plus the implementation of Phase III of the Umatilla Basin Project.
2) Habitat restoration of the top 19 geographic areas plus implementation of Phase III.
3) Habitat restoration of the top 19 geographic areas with no implementation of Phase III.

Results of these scenario runs were used to develop working hypotheses regarding the impact of the restoration actions on the abundance of naturally produced adults and the productivity of the population.

Aquatic Working Hypotheses
The following working hypotheses were developed for each anadromous focal species from the results of the EDT modeling.

***Steelhead* –** EDT estimate of current abundance = 2,650 adults and productivity = 4.9

1) Restoration of the top priority geographic area (the area ranked 1) plus the implementation of Phase III will result in no impact on productivity and an increase in returning adult abundance by approximately 2% (adult abundance = 2,705).

2) Restoration of the top 19 priority geographic areas plus implementation of Phase III will result in an increase of productivity by 43% (a value of 7.0) and an increase in returning adult abundance by approximately 36% (an abundance of 3,610 adults).

3) Restoration of the top 19 priority geographic areas with no Phase III will result in an increase in productivity by 37% (a value of 6.7) and an increase in returning adult abundance by approximately 30% (an abundance of 3,443 adults).

***Spring Chinook* –** EDT estimate of current abundance = 440 adults and productivity= 2.3

1) Restoration of the top priority geographic area (the area ranked 1) plus the implementation of Phase III will result in an increase in productivity by 42% (a value of 3.4) and an increase in returning adult abundance by approximately 152% (adult abundance = 1,108).

2) Restoration of the top 19 priority geographic areas plus implementation of Phase III will result in an increase of productivity by 100% (a value of 4.6) and an increase in returning adult abundance by approximately 287% (an abundance of 1,702 adults).

3) Restoration of the top 19 priority geographic areas with no Phase III will result in an increase in productivity by 83% (a value of 4.2) and an increase in abundance of returning adults by approximately 127% (an abundance of 998 adults).

***Fall Chinook* –** EDT estimate of current abundance = 0 adults and productivity = 0.4

1) Restoration of the top priority geographic area (the area ranked 1) plus the implementation of Phase III will result in an increase in productivity by 200% (a value of 1.2) and an increase in returning adult abundance to approximately 1,457 fish.

2) Restoration of the top 19 priority geographic areas plus implementation of Phase III will result in an increase of productivity by 350% (a value of 1.8) and an increase in returning adult abundance to approximately 4,192 fish.

3) Restoration of the top 19 priority geographic areas with no Phase III will result in an increase in productivity by 275% (a value of 1.5) and an increase in abundance of returning adults to approximately 3,005 fish.

***Coho* –** EDT estimate of current abundance = 0 adults and productivity = 0.4

1) Restoration of the top priority geographic area (the area ranked 1) plus the implementation of Phase III will result in an increase in productivity by 25% (a value of 0.5); however, the number of adult returns will continue to be so small as to be negligible (i.e., recognized as 0 by EDT).

2) Restoration of the top 19 priority geographic areas plus implementation of Phase III will result in an increase of productivity by 150% (a value of 1.0) and an increase in returning adult abundance to approximately 69 fish.

3) Restoration of the top 19 priority geographic areas with no Phase III will result in an increase in productivity by 125% (a value of 0.9); however, the number of adult returns will continue to be so small as to be negligible (i.e., recognized as 0 by EDT).

Not surprisingly, these results suggest that the greatest amount of action (restoring all 19 geographic areas and implementing Phase III) has the greatest impact on steelhead and salmon productivity and abundance. However, the relative benefit of different actions varies among the species. For example, implementation of Phase III has a relatively small impact on steelhead, while restoring all 19 areas has a large impact. In contrast, implementing Phase III and restoring only the most important geographic area has a greater impact on spring Chinook than restoring all 19 areas and not implementing Phase III. A future challenge will be to examine the economic cost effectiveness, cultural, social, and political ramifications of each restoration scenario.

1.2.9 Terrestrial Wildlife Assessment

General Approach

The terrestrial wildlife assessment is based on an approach that not only considers focal species but also the habitats on which they depend. By combining a “coarse filter” (focal habitats) with a “fine filter” (focal wildlife species assemblage) approach, subbasin planners believe there is a much greater likelihood of maintaining, protecting and/or enhancing key focal habitat attributes and providing functioning ecosystems for terrestrial wildlife. This approach not only identifies priority focal habitats, but also describes the most important habitat conditions and attributes needed to sustain obligate wildlife populations within these focal habitats. These habitat attributes are termed “key environmental correlates”. Subbasin planners assume that conservation and management directed towards focal species will establish conditions that will also benefit a wider group of species with similar habitat requirements.

The use of focal species also has the additional benefit of drawing immediate attention to habitat features and conditions most in need of conservation or most important in a properly functioning ecosystem. These focal species can serve as “poster” species for a given habitat type, helping stakeholders and the public to better relate to the somewhat abstract notion that habitats are often the primary target of management actions, not species.

Umatilla/Willow subbasin planners selected ten focal species from a list of focal candidates that met one or more of the categories indicating ecological importance. These species were associated with eight focal habitats and have life requirements representative of habitat conditions or features that are important within properly functioning focal habitats. Planners also looked for species to provide a focus for describing desired habitat conditions, attributes, and needed management strategies and/or actions. The ten focal species and eight focal habitats are described below.

The terrestrial assessment was conducted using existing data on the Umatilla/Willow subbasin in combination with a new product, the Interactive Biodiversity Information System (IBIS), which was made available through the subbasin planning effort. In most cases, IBIS was relied on for providing information on 1) wildlife species occurrences in the subbasin, 2) the ecological and conservation status of those species, 3) historic and current distribution of habitat types found in the subbasin, 4) general information about focal habitats, 5) information on the ownership and protection status for each habitat, and 6) functional redundancy analyses. However, in some cases data generated from IBIS were clearly inaccurate; in these cases, other sources were used if possible. In other cases, the data seemed questionable; in these cases, caveats are expressed in the text. Another limitation of the database, and of current knowledge in the subbasin, is a lack of quantitative information on habitat quality, especially in regards to the key environmental correlates of focal species.

Terrestrial Wildlife Assessment Results

Results specific to each focal habitat type, including status, limiting factors, focal species selected, working hypothesis, and current protection and ownership, are presented below. A general discussion of opportunities and data gaps and uncertainties follows.

Mixed Conifer Forest: Mixed conifer forest in the subbasin is estimated to have doubled in area since c. 1850. However, the quality of mixed conifer forest is believed to have decreased primarily because of timber harvest and altered fire regimes. Other factors that negatively impact mixed conifer forest habitat quality are ponderosa pine encroachment, development, outbreaks of western spruce budworm and Douglas-fir tussock moth, and exotic plant invasions. Mature mixed conifer stands (dominated by trees 150-300 years old) are believed to be rare. The Pileated Woodpecker was selected as a focal species for mixed conifer forest because mature conifer forest provides the necessary key environmental correlates required by the Pileated Woodpecker. Pileated Woodpeckers are believed to have declined in the subbasin because of the limited amount of high quality mixed conifer habitat. Thus, management strategies that address limiting factors of the habitat are expected to benefit the Pileated Woodpecker and other wildlife species strongly associated with mature conifer habitat. Most (>90%) of the mixed conifer habitat in the Umatilla/Willow subbasin is under no or low protected status and most (67%) is federally owned, suggesting that strategies aimed at increasing protection and enhancement by working with federal agencies should be emphasized.

Ponderosa Pine Forest: Ponderosa pine forest in the subbasin is estimated to have increased in area by 10% since c. 1850. However, the quality of ponderosa pine forest is believed to have decreased primarily because of timber harvest, altered fire regimes and stand replacing fires, and mixed conifer encroachment. Other factors that negatively impact ponderosa pine forest habitat quality are exotic plant invasion, outbreaks of western spruce budworm and Douglas-fir tussock moth, livestock grazing, development, and recreational activities. Old growth ponderosa pine stands (dominated by trees > 150 years old) are believed to be rare. The White-headed Woodpecker was selected as a focal species for ponderosa pine forest because old growth ponderosa pine provides the necessary key environmental correlates required by the White-headed Woodpecker.

White-headed Woodpeckers are believed to have declined in the subbasin because of the limited amount of high quality ponderosa pine habitat. Thus, management strategies that address limiting factors of the habitat are expected to benefit the White-headed Woodpecker and other wildlife species strongly associated with old growth ponderosa pine. Most (>90%) of the ponderosa pine habitat in the Umatilla/Willow subbasin is under no or low protected status and most (61%) is privately owned, suggesting that strategies aimed at increasing protection and enhancement by working with private landowners should be emphasized.

Quaking Aspen: An estimated 94% of quaking aspen forest in the Umatilla/Willow subbasin has been lost since historic times (c. 1850). Although good data on current distribution of quaking aspen are lacking for most of the subbasin, less than 100 acres are estimated to remain. In addition, subbasin planners believe that much of the remaining habitat is degraded primarily by intensive grazing of livestock and native ungulates, fire suppression, and the invasion of coniferous species. The Red-naped Sapsucker was selected as a focal species for quaking aspen because the habitat provides the necessary key environmental correlates required by the Red-naped Sapsucker. Red-naped Sapsuckers are believed to have declined in the subbasin because of the limited amount of high quality quaking aspen habitat. Thus, management strategies that address limiting factors of the habitat are expected to benefit the Red-naped Sapsucker and other obligate quaking aspen species. Although no data are available from IBIS on the ownership or protected status of the limited amount of quaking aspen habitat in the subbasin, subbasin planners believe that most of it is on CTUIR or federal lands with an uncertain protected status. Thus, strategies aimed at increasing protection and enhancement by working with federal and tribal agencies should be emphasized.

Western Juniper: Data provided by IBIS concerning the present and historic distribution of juniper in the Umatilla/Willow subbasin are questionable. An alternative source suggests that juniper habitat associated with grassland and shrub-steppe is believed to have decreased by 50-65% since historic times. In contrast, the current distribution of mid-elevation transitional zone juniper woodland is believed to have remained relatively constant. Regardless of the amount currently in existence in the subbasin, subbasin planners believe the quality of this habitat has declined because of agricultural conversion, altered fire regimes, overgrazing, and exotic plant invasions. Mature juniper trees and stands are believed to be particularly rare. The Ferruginous Hawk was selected as a focal species for western juniper because mature juniper trees and stands provide the necessary key environmental correlates required by the Ferruginous Hawk. Ferruginous Hawks are believed to have declined in the subbasin because of the limited amount of high quality western juniper habitat. Thus, management strategies that address limiting factors of the habitat are expected to benefit the Ferruginous Hawk and other obligate western juniper species. Most (99%) of the western juniper habitat in the Umatilla/Willow subbasin is believed to be unprotected and most (99%) is privately owned, suggesting that strategies aimed at increasing protection and enhancement by working with private landowners should be emphasized.

Shrub-Steppe: Data provided by IBIS concerning the present and historic distribution of shrub-steppe in the subbasin are questionable. An alternative source suggests that certain types of shrub-steppe habitat, primarily low-elevation shrub-steppe types, have decreased dramatically since historic times; big sagebrush steppe has declined by an estimated 86% and bitterbrush habitat has declined by an estimated 55%. In addition, the remaining remnants of these types of sagebrush habitats are believed to be heavily degraded. Major factors affecting shrub-steppe habitat in the Umatilla/Willow subbasin are agricultural conversion (including the conversion of CRP lands back into croplands), exotic plant invasion, alteration of fire regimes, purposeful seeding of non-native grasses, and livestock grazing. The Sage Sparrow was selected as a focal species for shrub-steppe because the habitat provides the necessary key environmental correlates required by the Sage Sparrow. Sage Sparrows are believed to have declined because of limited high quality shrub-steppe habitat. Thus, management strategies that address limiting factors of the habitat are expected to benefit the Sage Sparrow and other obligate shrub-steppe species. Five areas identified in the assessment contain not only a large portion of the existing low-elevation shrub-steppe habitat in the subbasin (up to 50%), but also the largest and highest quality remnants of low-elevation shrub-steppe. These areas are also significant because many of them have large portions of land that are owned or controlled by the federal government and TNC. Thus, these five areas represent an excellent opportunity to protect and enhance some of the best existing low-elevation shrub-steppe in the Umatilla/Willow subbasin through cooperation with the federal government, TNC, and private landowners.

Interior Grasslands: Interior grasslands in the Umatilla/Willow subbasin are estimated to have declined by 74% since historic times (c. 1850). In addition, subbasin planners believe that the quality of remaining grassland habitat has also decreased. Major factors affecting interior grasslands in the subbasin are agricultural conversion (including the conversion of CRP back into cropland), exotic weed invasion, purposeful seeding of non-native grasses, overgrazing, and human-altered fire regimes. The Grasshopper Sparrow was selected as a focal species for grassland habitat because high quality grasslands provide the necessary key environmental correlates required by the Grasshopper Sparrow. Grasshopper Sparrows are believed to have declined because of limited high quality grassland habitat. Thus, management strategies that address limiting factors of the habitat are expected to benefit the Grasshopper Sparrow and other wildlife species strongly associated with high quality grassland habitat. Most (99%) grassland habitat in the Umatilla/Willow subbasin is under no or low protected status and most (82%) is privately-owned, suggesting that strategies aimed at increasing protection and enhancement by working with private landowners should be emphasized.

Herbaceous Wetlands: The area of herbaceous wetland habitat in the Umatilla/Willow subbasin is estimated to have declined by 75% since historic times (c. 1850), with only 4,670 acres estimated to occur in the subbasin presently. In addition, the quality of remaining herbaceous wetlands is believed to have decreased. Major factors that have led to the destruction and degradation of herbaceous wetlands in the Umatilla/Willow subbasin are habitat conversion and draining, lowering of ground water level, separation of floodplain from the stream channel due to dikes and levees, exotic plant and animal invasions, and livestock grazing. The Columbia spotted frog was selected as a focal species for herbaceous wetlands because good quality habitat provides the necessary key environmental correlates required by Columbia spotted frog. Columbia spotted frogs are believed to have declined because of limited high quality herbaceous wetland habitat. Thus, management strategies that address limiting factors of the habitat are expected to benefit the Columbia spotted frog and other obligate herbaceous wetland species. Most (86%) herbaceous wetland habitat in the Umatilla/Willow subbasin is under no or low protected status and most (74%) is privately owned, suggesting that strategies aimed at increasing protection and enhancement by working with private landowners, especially through cooperative programs and education, should be emphasized.

Riparian Wetlands: The amount of riparian wetland habitat presently occurring in the Umatilla/Willow subbasin is uncertain. Estimates suggest that from 86% to 99% of riparian wetlands have been lost in the subbasin since historic times (c. 1850). In addition, the quality of remaining riparian wetlands is believed to have declined. Major factors affecting riparian wetlands in the Umatilla/Willow subbasin are agricultural and urban development, exotic weed invasion, timber harvest, livestock grazing, transportation corridors, hydropower, and recreational activities. The Great Blue Heron, the Yellow Warbler, and the American beaver were selected as focal species for riparian wetlands because high quality riparian wetlands provide the necessary key environmental correlates required by these species. All three species are believed to have declined because of limited high quality riparian habitat. Thus, management strategies that address limiting factors of the habitat are expected to benefit all three species and other wildlife species strongly associated with high quality riparian habitat. Most (>94%) of the riparian wetland habitat in the Umatilla/Willow subbasin is estimated to be under no or low protected status. However, the ownership status of riparian wetlands is unclear, with estimates differing over whether most riparian wetland habitat is found on private land or CTUIR land. Regardless, strategies aimed at increasing protection and enhancement by working with either CTUIR and/or private landowners should be emphasized.

General Considerations: Although opportunities for protection and enhancement of each focal habitat are dictated by its protected status and ownership, and thus vary by habitat, a general opportunity to protect and enhance wildlife habitat and populations applies to all habitat types. As discussed above, a large portion of the subbasin's economy is related to agriculture, which is often pitted against fish and wildlife interests in other areas. The Umatilla/Willow subbasin is unique in that agricultural, tribal, and governmental groups, as well as other stakeholders, have worked together to form mutually acceptable solutions to fisheries and wildlife problems in the past. This past history of success is an opportunity in the sense that it has developed a foundation of trust and cooperation that can be capitalized on in the future. Thus, subbasin planners are committed to continuing with this cooperative model as they develop and implement terrestrial wildlife objectives and strategies.

Finally, data gaps and uncertainties became obvious during the terrestrial wildlife assessment. Although the magnitude of uncertainty varies by habitat, the following actions are needed to fill those gaps: 1) obtain data on the quality of focal habitats in the Umatilla/Willow subbasin, including data on ecological function as related to the focal and other obligate species, 2) refine or gather information on habitat suitability for focal species in the subbasin, 3) refine and field-truth data on the location, size, spatial distribution, ownership, and protected status of focal habitats, 4) identify areas in the subbasin that could be converted to enlarge habitat patches, provide new reservoir habitat, or enhance connectivity between two or more extant patches, 5) generate population and distribution data for focal and other obligate species in the Umatilla/Willow subbasin, and 6) determine the amount of high quality habitat needed to support viable populations of focal species in the subbasin.

1.3 Summary of the Inventory

The inventory presents a brief summary of the important legal protections, management plans, management programs, and projects in the subbasin. Legal protections are laws and legal agreements that protect both species and habitats (e.g., the Wilderness Act, conservation leases). Management plans are existing plans that guide conservation and restoration practices, development, and land use practices. Management programs are programs designed to assist governmental bodies or private individuals in the management of their lands (e.g., CRP and EQIP programs in the federal Farm Bill). The project inventory is a listing of restoration projects that have been conducted in the subbasin and designed to restore fish and wildlife habitat.

The final section of the inventory is a gap analysis designed to determine whether existing projects have been addressing the limiting factors identified in the assessment and if those projects have been conducted in the appropriate geographic areas as identified in the assessment. The gap analysis revealed that, in general, existing projects have been addressing the appropriate limiting factors. However, the gap analysis suggests there are some priority areas that have received little attention in terms of projects. These conclusions need to be interpreted with great caution. Many projects were started 5 to 10 years ago, and some are older than that, and our identification of limiting factors and priority geographic areas is based on data that ranges from 10 years old to less than one year old. Therefore, we do not know what conditions were like when projects began and it is erroneous to conclude that projects have been misplaced (either geographically or in terms of the limiting factor they address). In addition, the gap analysis cannot be used to determine the success of projects because managers do not know the conditions of limiting factors before the projects began and how they changed after project implementation. This issue identified one of the major data gaps in the subbasin: good data on the effectiveness of projects. This gap does not result from a lack of desire by local biologists and managers, but a lack of funding being made available for rigorous monitoring and evaluation of projects. Therefore, the gap analysis is of limited usefulness and can only provide a very general guide on whether future actions should follow past actions.

1.4 Summary of the Management Plan

The management plan for the Umatilla/Willow subbasin begins with a vision statement, which describes the desired future condition of the subbasin and reflects the current conditions, values, and priorities of the subbasin in a manner that is consistent with the Council's vision described for the Columbia basin. The following vision statement for the Umatilla/Willow subbasin was adopted by the Core Partnership on November 6, 2003 and was presented and approved at a public meeting on November 12, 2003.

> The vision for the Umatilla/Willow subbasin is a healthy ecosystem with abundant, productive, viable, and diverse populations of aquatic and terrestrial species, which will support sustainable resource-based activities that contribute to the social, cultural, and economic well-being of the communities within the subbasin and the Pacific Northwest.
>
> This vision entails several broad goals for the subbasin that can be categorized as human use; habitat; population; and research, monitoring, and evaluation goals.

Human Use

- Provide for non-consumptive recreational, educational, aesthetic, scientific, economic, cultural, and religious uses of the subbasin's diverse fish and wildlife resources.
- Provide for sustainable consumptive, ceremonial, subsistence, and recreational uses of the subbasin's diverse fish and wildlife resources.
- Provide for sustainable resource-based activities to support the economies and cultures of the communities within the subbasin.

Habitat

- Protect existing high quality fish and wildlife habitat and strongholds.
- Restore and enhance degraded and diminished fish and wildlife habitats to support population restoration goals and to mitigate impacts from the construction and operation of the Columbia basin hydropower system and other anthropogenic impacts.
- Restore the health and function of ecosystems in the Umatilla/Willow subbasin to ensure continued viability of their natural resources.

Population

- Maintain and enhance the diversity, abundance and productivity of existing fish and wildlife populations within the subbasin.
- Strive for de-listing and avoidance of future listings of native fish and wildlife species in the subbasin under state and federal Endangered Species Acts.
- Restore and maintain self-sustaining populations of extirpated species consistent with habitat availability, public acceptance, and other uses of the lands and waters of the state.

Research, Monitoring, and Evaluation

- Develop a research, monitoring, and evaluation plan for the ecosystems of the subbasin that is consistent with and complements the larger regional efforts to track the status of fish and wildlife populations and their habitats as needed for appraising management actions, the results of these actions, and for evaluating other environmental changes.

The development of objectives and strategies for the subbasin's aquatic and terrestrial wildlife management plan was driven by the vision, the current biological and ecological conditions in the subbasin, and the economic and social realities described in the assessment. The biological objectives describe the physical and biological changes within the subbasin needed to achieve the vision. When forming aquatic and wildlife biological objectives and strategies, subbasin planners worked to satisfy the criteria set forth by the Council (2001) in its *Technical Guide to Subbasin Planners* and to ensure consistency of the plan with the requirements of the Endangered Species Act and the Clean Water Act.

1.4.1 Aquatic Management Plan

A general objective for aquatic focal species is to enhance natural productivity and to develop strategies to produce enough returning adults to support both tribal and sports fisheries and to support a large enough escapement to increase natural productivity. This objective will be met through both enhancing natural production and continuing to supplement populations through artificial production.

Natural Production -- Objectives and Strategies

In the Umatilla River subbasin the main objective is to improve habitat of the focal species to increase productivity and abundance. In addition, another objective is to improve access to many areas of the subbasin.

In the Willow Creek subbasin the main objective is the same: improve habitat for focal species to increase productivity and abundance. Another objective in this subbasin is to improve passage barriers to a degree that will allow summer steelhead to re-populate the subbasin.

To address these objectives, 14 strategies were developed by the Umatilla/Willow Creek Subbasin Aquatic Working Group. These strategies, with a brief explanation, are not listed in order of priority here, but are prioritized by geographic area as related to primary limiting factors in the management plan.

1) Maintenance of Phase I and II, and implementation of Phase III Umatilla Basin Projects. Under Phase III, summer flows in the Umatilla River will be enhanced (and water temperatures decreased) from Thornhollow Springs to the mouth.
2) Purchase water rights from willing sellers. Purchased water rights can come from water directly removed from the Umatilla or Willow mainstems and tributaries or from McKay and/or Willow Creek reservoirs. This water can then be left instream or released from McKay or Willow Creek reservoirs to enhance flows and decrease temperatures.
3) Depending on return flows and impacts to water temperature, water conservation and irrigation efficiency projects can be a tool. This strategy will aid in improving streamflow by reducing the quantity of water withdrawn for agricultural, industrial or municipal purposes. Typical conservation projects include conversion of flood irrigation systems to sprinklers, piping and lining of irrigation ditch systems, irrigation scheduling and water management, and decreased watering of lawns by municipalities.

4) Modify zoning and flood control planning through regulatory actions. By working to improve zoning ordinances to prevent development of riparian areas and floodplains, better riparian function and channel-floodplain connection can be attained and/or maintained.
5) Place large woody debris and large boulders. Where opportunities exist, work on public, federal, state, tribal and private lands will be conducted to improve instream habitat. Placing large woody debris and large boulders directly increases habitat complexity and can improve habitat quantity by increasing the number of pools.
6) Fence and plant riparian zones. Where opportunities exist, work on public, federal, state, tribal and private lands will be conducted to improve riparian habitat. Fencing is installed to manage use of the riparian zone by livestock and planting of native vegetation is done to speed the recovery process once grazing or other land uses have been modified. Riparian habitat improvements can directly impact stream temperatures and sediment inputs (through stabilizing streambanks and filtering runoff).
7) Modify channel and floodplain function. Where opportunities exist, work on public, federal, state, tribal, and private lands will be conducted to improve form and function of stream channels. This work involves directly or indirectly returning stream channels to a functional state that is determined by the valley form, geology, soils, vegetation and climate. Specific parameters often targeted by this type of work include channel width and depth, sinuosity, slope, flood prone area, and ratio of channel features.
8) Construct pool and riffle habitat using in-stream modifications. Where opportunities exist, work on public, federal, state, tribal and private lands will be conducted to increase the quantity of pools and gravel dominated riffles (as opposed to cobble). Straightening and entrenchment of stream channel is a common problem in the Umatilla Basin that leads to the reduction of pool habitat and gravel dominated riffles. Pools will be constructed by direct intervention, often concurrently with work to restore channel form and function, and the quantity of gravel dominated riffles will be improved by decreasing channel slope, reducing entrenchment and confinement, and restoring pool/riffle sequencing.
9) Maintain, relocate, or eliminate forest, public, and private roads in riparian and sensitive areas. Where opportunities exist, work on public, federal, state, tribal, and private lands will be conducted to address problems caused by roads. Roads are a source of sediment and a means of rapidly routing sediment to streams, occupy historic riparian zones, and often result in stream confinement. Maintenance, relocation or removal of roads are the primary tools for addressing the problems.
10) Increase protective status of priority habitats. Where habitats have high value due to their current productive capacity or general importance to particular species, they should be protected to maintain their value. This can be accomplished by easements and other kinds of natural resource protection agreements, or on public lands by varying kinds of protections authorized by statute or rule.

11) Modify detrimental land use activities. Change land use activities leading to degradation of habitat, thereby allowing stream attributes impacted by these activities to recover without intervention. A common example of this kind of work is riparian buffers where streamside areas are protected from uses such as livestock grazing or agricultural crops.
12) Restore upstream or headwater attributes to improve downstream conditions. In particular, water quality problems are cumulative in a downstream direction. Sources of water quality problems at a particular location can often be sourced to areas upstream. This is also true of large wood debris. The source of large woody debris for some reaches can be primarily from upstream reaches. Limiting factors such as fine sediment, water temperature and large wood debris should be addressed at the watershed scale as well as the reach/geographic area scale. Understanding of these problems at the watershed scale is necessary, however, to effectively work at this scale. Actions such as restoration of riparian vegetation and channel function upstream of areas limited by temperature, sediment and/or large wood should be particularly effective.
13) Increase passage efficiency of in-stream obstructions including culverts, bridges, diversion structures, and unscreened diversions. Correction of passage deficiencies should be corrected wherever they exist.
14) Maintain passage efficiency. Structural fixes installed to provide fish passage over irrigation dams require maintenance to operate within design criteria. All fish passage facilities should be maintained to provide optimal passage conditions.

Artificial Production – Objectives and Strategies
The main objective of artificial production in the subbasin is to supplement natural production to support tribal and sport fisheries and to provide an abundance of returning adults to augment spawning escapement.

The strategies to achieve this objective are:
1) Continue to supplement the recently reintroduced spring Chinook population with a hatchery program using Carson stock brood returning to the Umatilla River to provide for natural production and harvest.
2) Continue to supplement the recently reintroduced fall Chinook population with a hatchery program using upriver bright stock brood returning to the Umatilla River and Priest Rapids Hatchery to provide for natural production and harvest.
3) Continue to supplement the recently reintroduced coho population with a hatchery program using early run stock brood from Bonneville Hatchery to provide for natural production and harvest.
4) Continue to supplement the indigenous summer steelhead population with a hatchery program using native stock brood returning to the Umatilla River to enhance natural production and provide harvest opportunities.

1.4.2 Terrestrial Wildlife Management Plan

The development of 26 objectives and 90 strategies for the terrestrial wildlife management plan was driven by the vision for the subbasin, the current biological and ecological conditions, and the economic and social realities described in the assessment. The biological objectives for wildlife describe the physical and biological changes within the subbasin needed to achieve the vision. For wildlife, these objectives (and their associated strategies) are primarily described in terms of changes needed in focal habitats, rather than in population-related attributes of focal or obligate species. Focal species-centered objectives and strategies are not appropriate for wildlife because of the lack of adequate information available on focal species needed to form biological objectives. Instead, the wildlife plan is composed primarily of habitat-centered objectives and strategies that focus on the ecological function of the habitat (i.e., its ability to provide the key environmental correlates identified for the focal and other obligate species). Thus, the primary role of focal species in forming the management plan is in the use of their needs to define functional habitat and, in some cases, in the research, monitoring, and evaluation component of this plan.

Wildlife objectives and strategies were developed by the Umatilla/Willow Subbasin Terrestrial Wildlife Workgroup. An early draft set of objectives and strategies for three habitat types was presented at a public meeting on May 6, 2004 and suggestions provided at that meeting were used to revise the objectives and strategies. Objectives and associated strategies were developed for each habitat, with the exception of a general objective which applies to all eight focal habitats. This objective, which is not strictly a biological objective, was developed in response to data gaps that became apparent when conducting the subbasin assessment. Addressing these data gaps was deemed to be a high priority because the lack of knowledge presented a substantial obstacle in developing firm quantitative biological objectives for many habitats. Thus, completing this objective will be instrumental in implementing effective adaptive management in the subbasin for terrestrial wildlife species.

Biological objectives for each focal habitat type generally fall into one of three categories: protection, enhancement, and conversion. Protection objectives relate to increasing the legal or administrative protection of the habitat, although they do not preclude active management. In fact, the higher the protection, the more likely it is that management would prohibit activities that degrade or destroy habitat and would encourage practices that would mimic natural disturbances. Thus, there may be some overlap between objectives related to protection and those that address enhancement. However, enhancement objectives focus exclusively on maintaining or increasing the ecological function of focal habitats, especially with respect to focal and other obligate species. Finally, objectives related to conversion or restoration, seek to increase the amount of focal habitat in the subbasin by converting it or restoring it from some other habitat type. In general, for each habitat subbasin planners sought to protect a realistic amount of the best quality habitat, to enhance protected habitat, and to increase connectivity or size of existing habitat or create new reservoirs of habitat through conversion/restoration.

Where possible, objectives within each habitat type were prioritized. In addition, each set of strategies associated with an objective was also prioritized to the extent possible. Although multiple alternative strategies were considered for every objective, strategies rejected are not specifically listed under each objective because they generally fell into three categories: 1) strategies that were not consistent with the economic, political, or social realities of the subbasin, 2) strategies that were believed to have a low chance of success, and/or 3) strategies that were not as efficient at producing results as the strategies eventually selected.

Adaptive management plays a central role in the Umatilla/Willow wildlife plan, and is, in fact, built into the objectives. The completion of the first general objective will provide important information that can be used to refine and modify the biological objectives and strategies for each focal habitat, as needed. Additional information gained though research, monitoring, and evaluation will also be used to continually update the plan throughout its life.

1.4.3 Research, Monitoring and Evaluation

Research, monitoring, and evaluation (RM&E) plans were developed for both fish and wildlife programs. The goals of these plans are to monitor trends in focal species and habitats, evaluate the efficacy of management strategies in accomplishing objectives, and to conduct research to address critical uncertainties in the understanding of the biological and ecological systems in the subbasin and their management. A variety of methodologies for RM&E are presented both for fish and wildlife programs.

The enhanced RM&E plans currently under development address local management information needs. The draft plans will incorporate regional RM&E programs and protocols as they are developed. For the aquatic plan these protocols will come from the Collaborative System-wide Monitoring and Evaluation Project (CSMEP), the Pacific Northwest Aquatic Monitoring Partnership (PNAMP), and regional genetics monitoring. For the terrestrial plan these protocols will come from coordination among terrestrial wildlife managers who are currently working to develop standard protocols across the ecoregion. The draft RM&E plan reflects much of this coordination effort to date. The draft plans in Appendix H are working documents that will be finalized during the review process (to ensure regional and ISRP oversight is incorporated into the plans).

The RM&E plans support Independent Scientific Review Panel (ISRP), Confederated Tribes of the Umatilla Indian Reservation (CTUIR), and Oregon Fish and Wildlife (ODFW) recommendations, beyond current funding levels, to monitor fish and wildlife populations, status, distributions, and productivities and the habitats they require.

Literature Cited:

Council (Northwest Power Planning Council) (2001) *Technical Guide to Subbasin Planners*. Northwest Power Planning Council Document #2000-20, Portland, Oregon.

Oregon Subbasin Planning Coordination Group (2003) *Oregon Specific Guidance*. Revised version: September 15, 2003

Section 2. Introduction

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2. Introduction

2.1 Description of Planning Entity

The formal planning process for this draft began with the formation of the Umatilla/Willow Core Partnership in 2002. The Core Partnership is the lead entity for the subbasin planning process in the subbasin, and consists of representatives from six major stakeholder groups in the Umatilla/Willow subbasin: the Confederated Tribes of the Umatilla Indian Reservation (CTUIR), Morrow Soil and Water Conservation District (SWCD), Oregon Department of Fish and Wildlife (ODFW), Umatilla Basin Irrigation Districts Association (UBIDA), Umatilla Basin Watershed Council (UBWC), and Umatilla County SWCD. Members of the Core Partnership had the greatest role in the subbasin planning effort, and were responsible for taking the lead in coordinating among groups, developing the vision and biological objectives, and prioritizing subbasin strategies.

Members of a larger Stakeholder Group also played a vital role in the process by participating in reviews of early drafts and by attending five public meetings. The Stakeholder Group was composed of individuals or entities which reside in, derive their livelihood from, or are involved with business, research, or regulatory processes within the Umatilla/Willow subbasin, and members represented over 60 organizations, watershed councils, cities, counties, irrigation districts, state agencies, and federal and resource management agencies. In addition, three technical teams provided their expertise in the development and review of the plan. The General Technical Team was an interdisciplinary team that worked under the direction of the Core Partnership and was composed of specialists from various subbasin agencies and entities, as well as members of the Core Partnership. Members of this team reviewed the general information presented in the overview portion of the subbasin plan. Two more specialized teams, the Aquatic Workgroup and the Terrestrial Wildlife Workgroup, were responsible for providing the technical expertise for the development of the aquatic and terrestrial wildlife portions of the assessment and management plan. The Core Partnership hired a Project Manager to help compile, edit, and write various sections of the plan, and to facilitate technical team meetings and take the lead in compiling data contributed by agency staff. Two technical writers were also hired to work as principal authors of the plan. CTUIR was responsible for the fiscal management and contract administration involved with planning in the Umatilla/Willow subbasin.

2.2 List of Participants

Many individuals participated in the development of this draft. Participants that contributed to the writing or offered ideas and comments are listed in Table 1. This list includes participants involved in developing and writing the Draft Umatilla/Willow Creek Subbasin Summary (2001), which formed the starting point for this draft. In addition, numerous individuals attended the five public meetings that occurred during the planning process.

Table 1. List of contributors to this draft of the Umatilla/Willow subbasin plan.

Advisory Board of the Lower Umatilla Basin Ground Water Management Area	**Morrow Soil and Water Conservation District**
Ron Rickman	Janet Greenup
City of Pendleton	**National Oceanic and Atmospheric Administration**
Karen King	
Sue Lawrence	Nora Berwick
Robert Patterson	**Natural Resources Conservation Service**
Confederated Tribes of the Umatilla Indian Reservation	Chet Hadley
	Tom Bennett
	Northwest Habitat Institute
Janet Brim Box	Tom O'Neil
Craig Contor	Cory Langhoff
Allen Childs	**Oregon Department of Agriculture**
David Close	Tom Straughan
Kate Ely	**Oregon Department of Environmental Quality:**
Aaron Jackson	
Gary James	Don Butcher
Paul Kissner	**Oregon Department of Fish and Wildlife**
Michael Lambert	Susan Barnes
Scott O'Daniel	Tim Bailey
Eric Quaempts	Kevin Blakely
Gerry Rowan	Darren Brunings
	Will Cameron
Carl Scheeler	Shannon Jewett
Stacy Schumacher	Mark Kirsch
Jesse Schwartz	Russ Morgan
Amy Sexton	Scott Patterson
Todd Shaw	Greg Rimbach
	Tara White
Aaron Skirvin	**Oregon Natural Heritage Program**
Cheryl Shippentower	Eleanor P. Gaines
Jed Volkman	Jimmy Kagan
Jim Webster	**Oregon State University**
Brian Zimmerman	George Clough
Ecovista	Sandra DeBano
Anne Davidson	Gary Reed
Craig Rabe	David Wooster
Dora Rollins	**Oregon State University Extension Service**
Darin Saul	Donald Horneck
Human Dimensions Consulting	Randy Mills
William Warren	**Oregon Water Resources Department**
Morrow County	Tony Justice
Carla McLane	Michael Ladd

Table 1 (continued). List of contributors to this draft of the Umatilla/Willow subbasin plan.

Stewards of the Umatilla River Environment	**United States Department of Agriculture – Agricultural Research Service**
Betty Klepper	John Williams
Umatilla Basin Watershed Council	**United States Forest Service**
Ron Duetz	David Crabtree
Tracy Bosen	Charles Gobar
Mike Pelissier	Kristy Groves
Gary Rhinhart	Tom McLain
Umatilla County	Katherine Ramsey
J.R. Cook	Diane Shirley
Umatilla County Soil and Water Conservation District	**United States Fisheries and Wildlife Service**
Ray Denny	Keith Paul
Guy Hopkins	**Others**
Marty King	James Phelps
	Char Corkran
	Karen Kroner

2.3 Stakeholder Involvement Process

The Stakeholder Group (see Section 2.1 for description of members) and the general public were involved in the Umatilla/Willow subbasin planning process in a number of ways. Public meetings were held on June 4, 2002; August 6, 2003; November 12, 2003; March 3, 2004; and May 6, 2004. Members of the Stakeholder Group were sent postcards with meeting announcents several weeks in advance and the public was informed about public meetings through newspaper and radio announcements. In addition, early drafts of the document were made available for public review and comment on the Umatilla County Soil and Water Conservation District (SWCD) website. Members of the Stakeholder Group and the general public who did not have access to computers were encouraged to contact the Umatilla County SWCD for hard copies of drafts.

2.4 Overall Approach

2.4.1 Approach to the Development of the Plan

Several sets of guidance documents were followed by subbasin planners to maximize the likelihood that the plan would meet the requirements set forth by the Council. One of these documents, the *Technical Guide for Subbasin Planners* (Council 2001), describes three necessary components of subbasin plans: the assessment, the inventory, and the management plan. The assessment forms the scientific and technical foundation for developing the subbasin management plan; it not only describes the status and limiting factors of aquatic and terrestrial wildlife species and their habitats, but it also provides relevant information about the context in which fish and wildlife management takes place, including information on the social, economic, and cultural realities of the subbasin. The inventory summarizes and synthesizes fish and wildlife protection, restoration, and artificial production activities and programs within the subbasin that have occurred within the last five years, with the goal of demonstrating 1) current management directions, 2) existing protections, and 3) current strategies implemented through specific projects. These activities are related to limiting factors identified in the assessment. Another component of the inventory is a "gap analysis", which seeks to identify gaps between actions taken and actions needed. In combination with results from the assessment, the inventory should indicate the value and efficacy of current activities. The third component, the management plan, is described as the "heart" of the subbasin planning process (Council 2001). The primary goal of the management plan is to define the environmental and biological vision, objectives, and strategies specific to fish and wildlife in the subbasin. The planning horizon for the management plan is suggested to range from 10 to 15 years.

Another planning document that played an important role in guiding this draft of the Umatilla/Willow subbasin plan is the *Oregon Specific Guidance* (Oregon Subbasin Planning Coordination Group 2003). This document augments the guidance provided by the *Technical Guide for Subbasin Planners* (Council 2001) for Oregon subbasins. One guideline in this document that had a major effect on the organization and content of this draft plan is the stipulation that Oregon subbasin planners use a standardized outline[1]. Umatilla/Willow subbasin planners attempted to follow the outline provided by this document to the degree possible.

Using these technical guidance documents to direct the development of the plan, subbasin planners began their effort by incorporating all relevant information from the 2001 Draft Umatilla/Willow Creek Subbasin Summary into the current plan. The information was updated and corrected, as necessary, and supplemented with other existing sources of information. In addition, several new tools were made available to subbasin planners for fish and wildlife assessment. The Ecosystem Diagnosis and Treatment Model (EDT) was one of these tools and was used to identify limiting factors and prioritize geographic areas for restoration and protection for anadromous salmonid species. The Qualitative Habitat Analysis Model (QHA) was used to gather similar information for bull trout in the Umatilla River subbasin and redband trout in the Willow Creek subbasin. Terrestrial wildlife planners took advantage of a new wildlife database, the Interactive Biodiversity Information System (IBIS), to provide information on 1) wildlife species occurrences in the subbasin, 2) the ecological and conservation status of those species, 3) historic and current distribution of habitat types found in the subbasin, 4) general information about focal habitats, 5) information on the ownership and protection status for each habitat, and 6) functional redundancy analyses.

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[1] This stipulation reads as follows on p. 9 of the *Oregon Specific Guidance* "Oregon subbasin plans are required to use this outline for at least the first two levels (i.e., *[sic]* level 2.1, 4.1) for all sections except Section 3, which should include the first three levels (i.e., *[sic]* 3.1.1, 3.2.1, etc.)."

Work on the inventory began with existing information found in the Draft Umatilla/Willow Subbasin Summary (2001) and other documents. This information was supplemented with information received in response to a questionnaire sent out to 35 stakeholder groups in the Umatilla/Willow subbasin in July 2003 (see Appendix F for a copy of questionnaire and responses). The questionnaire requested updated information on existing protections, plans, management programs, and restoration and conservation projects. Further information was provided by members of the Core Partnership on activities being conducted by their agencies. This information was used in conjunction with the assessment results to conduct a gap analysis, which was designed to determine whether existing projects have been addressing the limiting factors identified in the assessment and if those projects have been conducted in the appropriate geographic areas as identified in the assessment.

Subbasin planners worked together to create the management plan. The primary goal of the management plan is to define the environmental and biological vision, objectives, and strategies specific to fish and wildlife in the subbasin. The vision statement for the Umatilla/Willow subbasin was adopted by the Core Partnership on November 6, 2003 and was presented and approved at a public meeting on November 12, 2003. The biological objectives describe the physical and biological changes within the subbasin needed to achieve the vision and the strategies are the actions need to achieve the objectives. The objectives and strategies were driven by the vision for the subbasin, the current biological and ecological conditions, and the economic and social realities described in the assessment. When sufficient information existed, strategies were prioritized. When forming aquatic and wildlife biological objectives and strategies, subbasin planners worked to satisfy the criteria set forth by the Council (2001) in its *Technical Guide to Subbasin Planners* and to ensure consistency of the plan with the requirements of the Endangered Species Act and the Clean Water Act. A partial set of aquatic and terrestrial management goals and objectives was presented at a public meeting on May 6, 2004 and suggestions provided at that meeting were used to revise the objectives and strategies.

Subbasin planners made a major effort to clearly establish linkages between the different components of the subbasin plan. Particular attention was paid to ensuring that linkages between the strategies, the biological objectives, the subbasin vision, and the assessment were obvious. In addition, planners also worked to ensure that the plan was consistent with the Council's scientific principles and program strategies.

2.4.2 Challenges Encountered

Significant challenges were encountered in the development of this plan. These challenges included:

- Insufficient time to adquately develop some products, especially with regard to EDT modeling
- Insufficient time to evaluate the consequences of missing data and other problems related to EDT modeling
- Inaccuracy of some information found in databases, such as IBIS
- Subbasin planning products or services falling short of original expectations

- An abundance of unreferenced material or incorrectly referenced material in earlier subbasin documents
- Difficulties interpreting and following the outline provided for Oregon subbasins
- Difficulties in reconciling guidance that directed subbasin plans to be brief on one hand, but complete on the other

Finally, subbasin planners constantly encountered the dilemma between the need for quantitative data in developing solid management plans and the lack of quality data in many cases. Ultimately, subbasin planners attempted to avoid "estimating" or "quantifying" when insufficient good quality data were available. Many aspects of fisheries and wildlife management are controversial, which makes the use of scientifically defensible data particularly important. For example, sufficient data do not exist to quantify the effects of most human disturbance in the subbasin in historic times. When tools are available to estimate the magnitude of these effects (such as EDT), subbasin planners used them. However, in many cases this is not possible. Attempting to quantify with insufficient data defeats one of the most important goals of subbasin planning: to produce a scientifically defensible management plan.

2.4.3 Comments on Presentation

As directed by technical guidance documents, subbasin planners tried to make the plan readable to the layperson, although extensive citations are used in some sections. Measurements are recorded in English units because of the convention of reporting stream locations in river miles, the use of acres in the IBIS database, and the widespread use of the English system in many of the source documents for local data. Common animal and plant names used in the text follow the convention established by the organization with responsibility for standardizing common names for each taxon. For most taxa, common names are not capitalized. Bird common names are the notable exception; the American Ornithologists' Union has determined that common names of birds are capitalized.

2.5 Process and Schedule for Revising/Updating the Plan

Once the draft Umatilla/Willow subbasin plan has been received by the Council on May 28, 2004, it will undergo an initial review by Council staff from May 29 through June 4, 2004 to determine if all the required components of the plan are included. On June 4, 2004, the plan will be sent to the Independent Scientific Review Panel (ISRP) and posted for public review on the Council's website at http://www.nwcouncil.org/. At that point, three simultaneous processes will take place between June 4 and August 12, 2004. The three reviews will be: 1) a scientific review by an expanded ISRP, which will include presentations by the subbasin planners on July 21 and 22, 2004 in Pendleton, 2) an adoptability review by Council staff to determine the adequacy of the plan under the Northwest Power Act (NWPA), and 3) a general review by NOAA, BPA, USFW, the states, public, and others. The comment period ends on August 12, 2004. With additional funding available through BPA, local subbasin planners will begin editing and re-writing the plan to incorporate review comments from all contributors. These changes will be completed by November 1, 2004, when the Council staff will compile all plans into a draft Fish and Wildlife Program Amendment. On November 18, 2004, the Council will propose the Draft Amendment of Subbasin Plans, with another public comment period occurring from November 10 to mid-December, 2004. The process will end during December 2004 and January 2005, when Council staff will meet again and adopt the plans.

If and when the Council adopts the Umatilla/Willow subbasin plan, the Core Partnership will coordinate efforts to assess the progress made in reaching the objectives of the plan and to use data obtained from research, monitoring, and evaluation activities to engage in adaptive management. Subbasin planners anticipate that these systematic reviews will occur every three years to allow sufficient time to collect data, obtain funding, and produce reports for the review process. The Core Partnership also plans to meet yearly in a more informal setting to share information about current and planned activities.

Literature Cited:

Council (Northwest Power Planning Council) (2001) *Technical Guide to Subbasin Planners*. Northwest Power Planning Council Document #2000-20, Portland, Oregon.

Oregon Subbasin Planning Coordination Group (2003) *Oregon Specific Guidance*. Revised version: September 15, 2003

Section 3. Subbasin Assessment

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Section 3. Subbasin Assessment

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3. Subbasin Assessment

3.1 Subbasin Overview

3.1.1 General Description

3.1.1.1 Location

The Umatilla and Willow Creek subbasins are two of a number of subbasins included within the Columbia Plateau ecological province[1] (Figure 1). Adjacent to these subbasins are two smaller drainages, Six-Mile Canyon and Juniper Canyon, which, along with the Umatilla and Willow Creek subbasins (Figure 2), are the subject of this plan. For the purpose of brevity, the term "Umatilla/Willow subbasin" will be used to refer to all four of these areas collectively.

The Umatilla subbasin lies within Umatilla and Morrow Counties, Oregon, with a negligible portion of the headwaters located in Union County. The Umatilla River originates in the Blue Mountains of northeastern Oregon and flows north and west to enter the Columbia River at river mile (RM) 289. The Umatilla subbasin extends west to Hermiston and the Sand Hollow drainage, south to Butter, Birch and McKay headwaters, east to Meacham and the North and South Fork Umatilla headwaters, and north to the Cold Springs drainage.

The Willow Creek subbasin lies to the west of the Umatilla subbasin, with 78% of it lying in Morrow County and 22% in Gilliam County. Willow Creek originates near Bald Mountain in the Umatilla National Forest and flows north and west to enter the Columbia River at RM 253. The Willow Creek western boundary is formed by the Eight-Mile Canyon drainage.

The Six-Mile Canyon drainage lies between the Umatilla and Willow Creek subbasins in Morrow County. This semi-arid area is drained by intermittent streams, which seldom enter into the Columbia River. The tributaries of this drainage include Six-Mile Canyon, Sand Hollow, and Juniper Canyon creeks. The "Juniper Canyon" which lies within the Six-Mile Canyon drainage will henceforth be called "Juniper Canyon-Ione," to distinguish it from the Juniper Canyon drainage that lies east of the Umatilla subbasin. When flow is sufficient, Juniper Canyon-Ione Creek enters the Columbia west of the Umatilla subbasin, 16 river miles downstream from the Umatilla/Columbia River confluence.

The fourth and smallest drainage of the Umatilla/Willow subbasin is the Juniper Canyon drainage, located north of the Umatilla subbasin in Umatilla County. Juniper Canyon Creek enters the Columbia River in Lake Wallula, approximately 11 miles upstream of McNary dam.

[1] The term "ecological province" used in this plan corresponds to the NWPCC definition of ecological province as a "group of adjoining subbasins with similar climates and geology" (NWPCC 2000). NWPCC recognized 11 ecological provinces (also termed "ecoprovinces") in the Columbia River basin (NWPCC 2000).

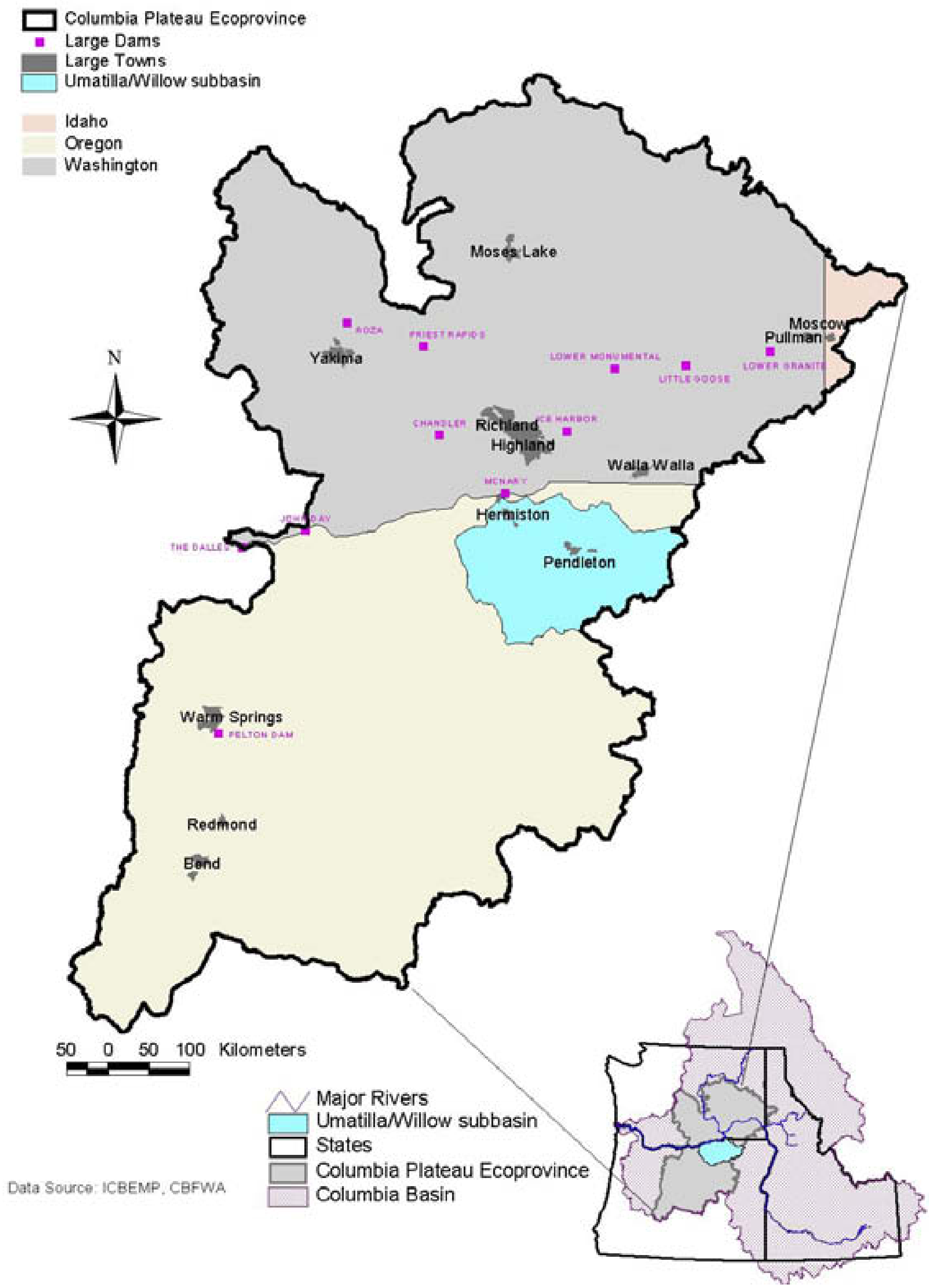


Figure 1. The Umatilla/Willow subbasin within the Columbia Plateau ecological province.

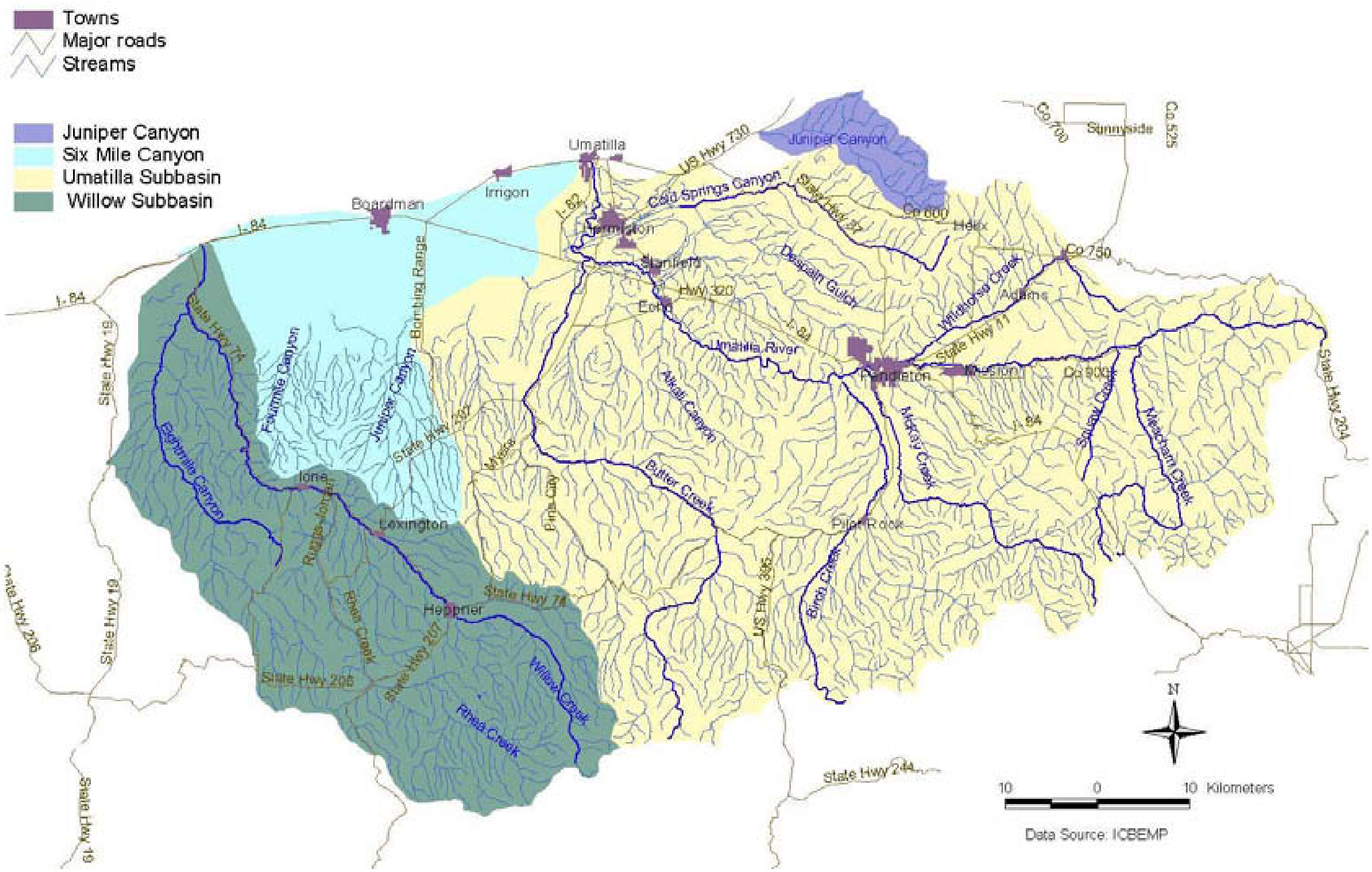


Figure 2. Assessment units and major features of the Umatilla/Willow subbasin.

3.1.1.2 Size

The mainstem Umatilla River is 89 miles long and the river and its tributaries drain an area of nearly 2,290 square miles (Gonthier and Harris 1977). Elevations in the Umatilla subbasin range from about 5,800 feet near Pole Springs on Thimbleberry Mountain to 260 feet at the mouth of the Umatilla River (Figure 3). Willow Creek is 79 miles long and drains an area of about 880 square miles. This subbasin ranges from 5,583 feet in elevation at its headwaters near Bald Mountain in the Umatilla National Forest to 260 feet at its confluence with the Columbia River (Figure 3). The Six-Mile Canyon area is 472 square miles and ranges in elevation from 3,084 feet at the headwaters of Sand Hollow Creek to 260 feet at its confluence with the Columbia River. The mainstem of Juniper Canyon Creek is 19 miles long and it drains 72 square miles. The headwaters of this creek occur at 1,935 feet and it enters the Columbia River at an elevation of 344 feet. The total area of the Umatilla/Willow subbasin is 3714 square miles.

3.1.1.3 Geology

The Umatilla/Willow subbasin consists of two geologic provinces: the Blue Mountains and the lower basin (sometimes referred to as the Umatilla plain). The Umatilla River and its tributaries begin in the Blue Mountains, which are characterized by deeply incised upland surfaces and a ramp-like slope called the Blue Mountain slope or foothills (USCOE 1947). The flat-topped ridges and steep stair-stepped valley walls of the Blue Mountains were formed by thousands of feet of Miocene basalt flows (USCOE 1947). These flows were part of a regionally widespread series of flows that formed the Columbia basin basalts and resulted in three major formations: the Saddle Mountain, Wanapum, and the Grande Ronde formations. Each basalt formation is an aggregation of smaller individual flows sharing similar flow histories and chemistry.

These flows were extruded from a regional volcanic vent system and filled the shallow basin of the Columbia Plateau (Gonthier and Bolke 1993). The thickness of each of these flow units ranges from five feet to as much as 150 feet, and collectively is estimated to be hundreds to thousands of feet thick (Newcomb 1965). As the mountains were further uplifted and the horizontal basalt layers warped into a series of folds, streams carved canyons through the basalt layers, creating a highly dissected landscape (Davies-Smith et al. 1988). The structural deformation of the basalt and its subsequent erosion created the varied topography of the Blue Mountains and their foothills.

Streams leaving the canyons of the Blue Mountains cross a wide expanse of plains and terraces making up the lower basin (Newcomb 1965). The lower basin is comprised of tertiary and quaternary loess, alluvium, glacio-fluvial, and lacustrine sediment deposits which mantle the Columbia River basalts across much of the lower elevations (Newcomb 1965). During the tertiary period, ancestral streams washed the oldest of the valley sedimentary deposits down from the canyons of the Blue Mountains and deposited them along the mountain front (Gonthier and Bolke 1993). Quaternary deposits of wind-borne silt, or loess, blanket much of the tertiary deposits and basalt flows in the subbasin. The

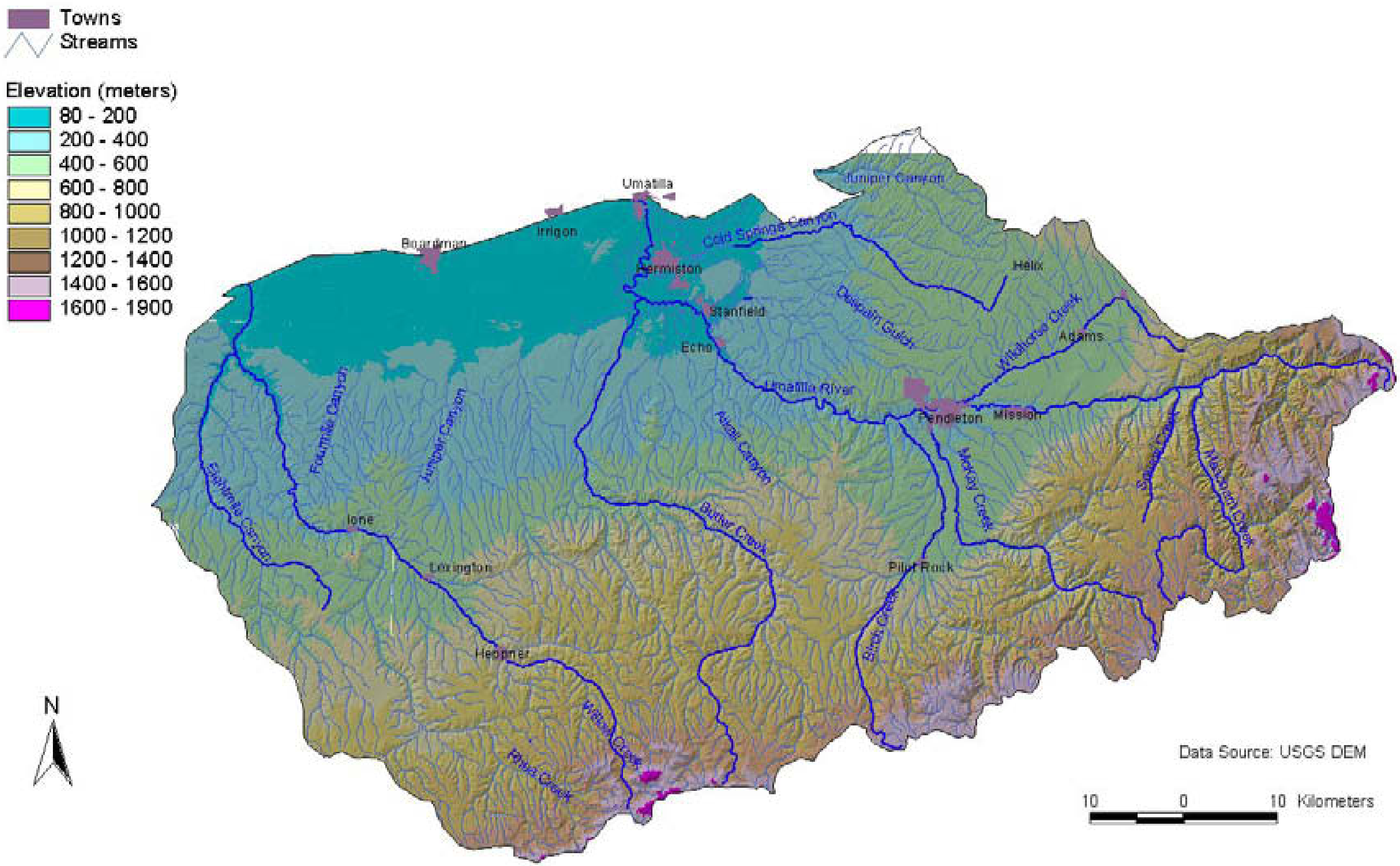


Figure 3. Elevation ranges in the Umatilla /Willow subbasin.

massive Missoula Floods that periodically inundated large areas of the Columbia Plateau from 12,800 to 15,000 years ago (Gonthier and Bolke 1993) also deposited approximately one meter of loess on top of lacustrine sediment. The highly productive soils that make the region famous for its agriculture are largely derived from these quaternary and tertiary deposits.

There are about 75 different soils in the Umatilla/Willow subbasin ranging from highly fertile loess and sand to ash derived from eruptions of volcanoes such as Mt. St. Helens in 1980, Mt. Mazama 6,000 years ago, and Glacier Peak 11,250 years ago (Johnson and Makinson 1988). Soils in the Blue Mountains and their foothills were formed in a variety of parent materials, including volcanic ash, residuum, loess, and colluvium (Johnson and Makinson 1988). Soils in the lower basin were formed in aeolian sand, loess, alluvium and lacustrine sediment (Johnson and Makinson 1988). Sandy soils are common at lower elevations of the Umatilla/Willow subbasin near the Columbia River, where swiftly moving waters, such as those associated with the Missoula Floods, deposited large-sized particles such as sand and gravel. These soils do not retain water well because of their low organic matter and coarse texture, and most sandy soils of the lower basin are not considered arable without pivot irrigation. Flooding from the Columbia River has also resulted in extensive silt deposits throughout the lower basin. Soils formed in silt often have a thin layer of loess at the surface. Although silty soils retain more water than sandy soils, irrigation is often still necessary in areas of low rainfall.

3.1.1.4 Climate and Weather

The entire Umatilla/Willow subbasin falls within Oregon's North Central Climatic Zone (Zone 6). The major influence on the regional climate is the Cascade Mountains to the west, which form a barrier against warm moist fronts from the Pacific Ocean (Johnson and Clausnitzer 1992). The Columbia Gorge provides a break in the curtain of the Cascade Mountains and occasionally allows moisture laden marine air to penetrate into the northern Blue Mountains. This induces light to moderate precipitation (depending on elevation), and results in vegetation common to the west slopes of the Cascades (Johnson and Clausnitzer 1992).

The subbasin experiences strong seasonal fluctuations in both temperature and precipitation. In the summer the subbasin experiences a continental climate with warm days, cool nights and little precipitation. Winters are much colder, with average temperatures often only slightly above freezing (Figure 4). Precipitation also changes dramatically with the seasons, with most precipitation in the subbasin falling during the fall, winter and spring (Figure 5).

The climate of the subbasin is also strongly influenced by elevation. Warm and dry conditions exist in the northwestern, low elevation portion of the subbasin. Here precipitation falls mainly as rain and often only nine inches fall annually (Figure 6). In contrast, up to 55 inches of precipitation falls in high elevation areas of the Blue Mountains (Figure 6) with much of this precipitation occurring as snowfall. These gradients in elevation and precipitation are also found in the Willow subbasin and Six-Mile

Canyon area, as demonstrated by differences recorded at the Boardman (elevation = 620 feet) and Heppner (elevation = 1890 feet) climate stations (Figure 7).

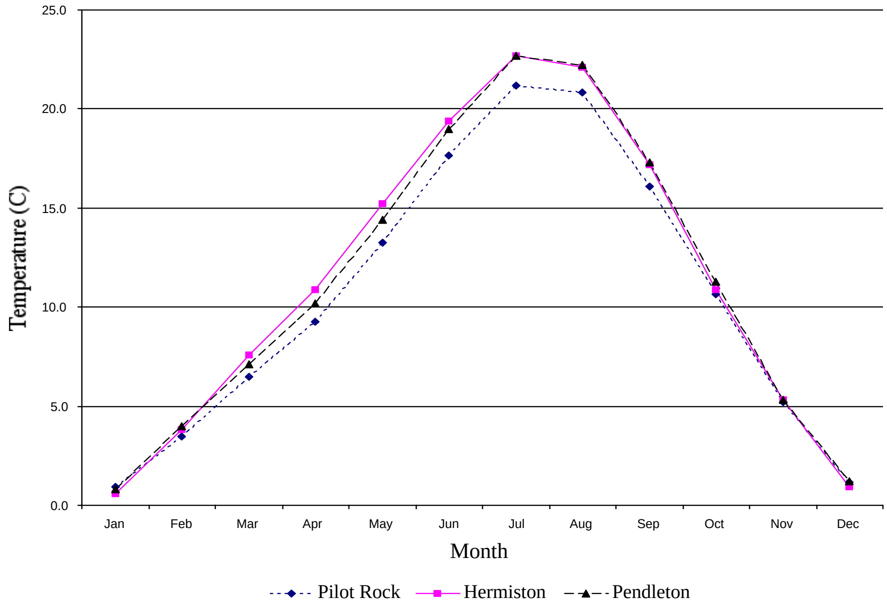


Figure 4. Average monthly temperature for three climate stations, Pilot Rock (elevation = 1,637 feet), Pendleton (elevation = 1,069 feet), and Hermiston (elevation = 450 feet), in the Umatilla subbasin, 1961-1990 (Oregon Climate Service 1999).

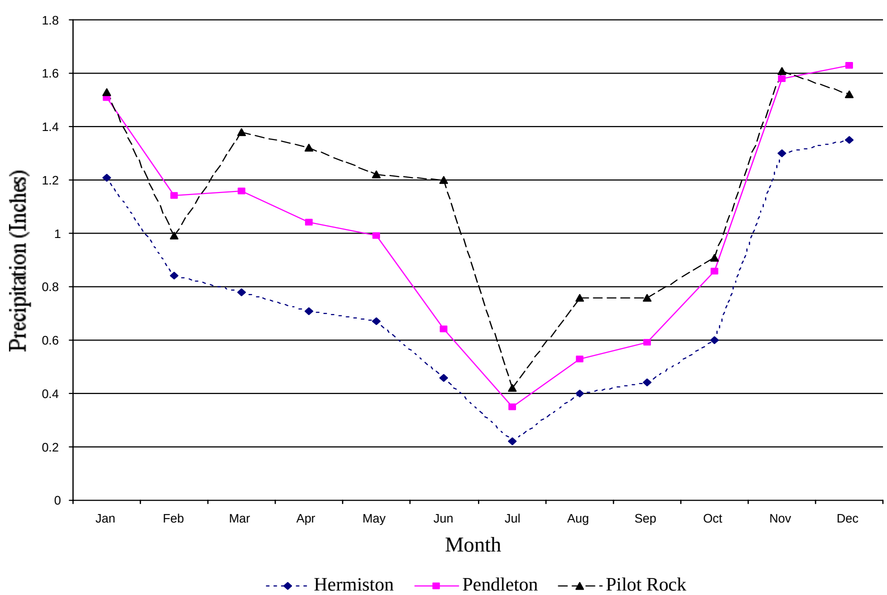


Figure 5. Average monthly precipitation at three climate stations, Pilot Rock (elevation = 1,637 feet), Pendleton (elevation = 1,069 feet), and Hermiston (elevation = 450 feet), in the Umatilla subbasin, 1961-1990 (Oregon Climate Service 1999).

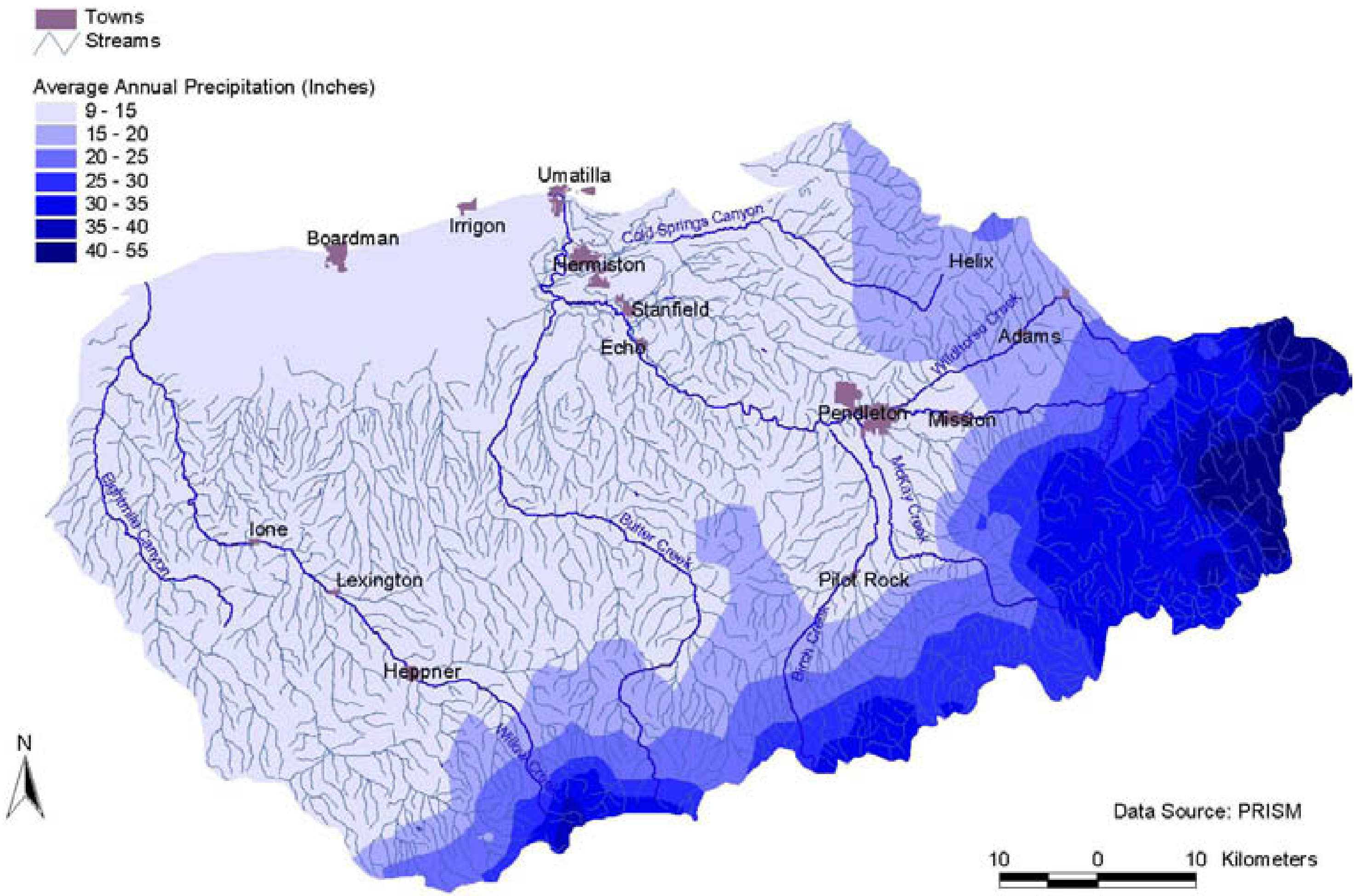


Figure 6. Precipitation ranges in the Umatilla /Willow subbasin.

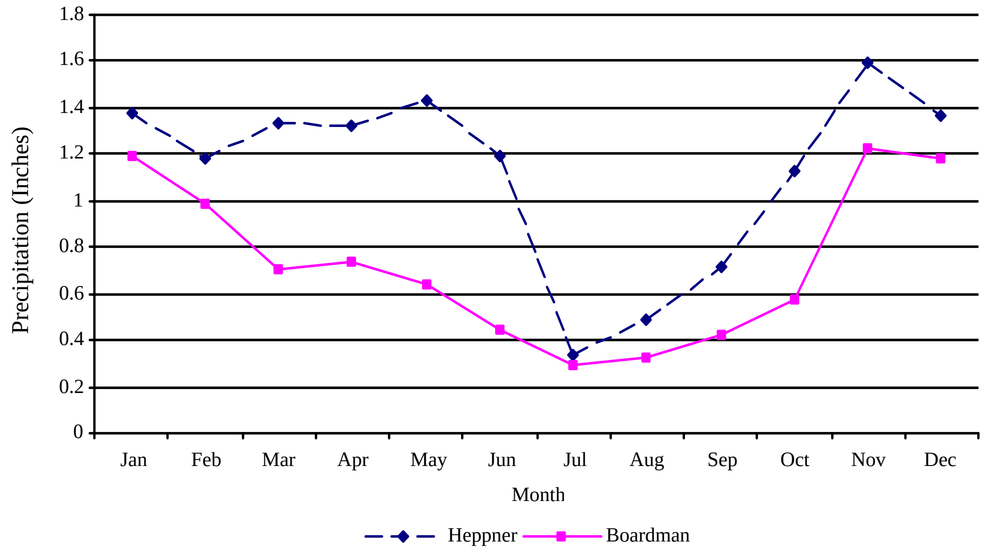


Figure 7. Average monthly precipitation at the Heppner and Boardman climate stations in the Willow Creek subbasin and Six-Mile Canyon area (respectively) (Oregon Climate Service 1999).

3.1.1.5 Land Cover

General types of land cover found in the Umatilla/Willow subbasin, in order of prevalence, include agricultural areas, shrub-steppe, grasslands, forested communities, urban areas, and riparian areas and other wetlands (Figure 8). Forested communities are associated with higher elevations and grassland and shrub-steppe are more common at lower elevations. General descriptions of the composition of natural vegetation land covers follow, but see Section 3.2.4.2 for more details.

Forested communities make up approximately 14% of the subbasin land cover (IBIS 2004), and are found primarily in the southern portion of the subbasin at mid and high elevations (Figure 8). Three types of forest communities are recognized: subalpine fir, mixed coniferous forest, and ponderosa pine forests. The subalpine fir community is found at the highest elevations and/or on north facing slopes. This community is generally limited by a short growing season and by low moisture availability on some sites. Coniferous species found in this community include subalpine fir, Engelmann spruce, and lodgepole pine. There is some overlap in species composition between the subalpine fir community and the mixed coniferous forest community (Quigley and Arbelbide 1997). The mixed coniferous forest community occurs primarily at mid to upper elevations and on all aspects in transitional areas between drier, lower elevation forests (ponderosa pine) and higher elevation subalpine forests. Mixed coniferous forests can include a variety of species such as grand fir, Englemann spruce, lodgepole pine, Douglas fir, western larch, and ponderosa pine (Quigley and Arbelbide 1997). The ponderosa pine forest occurs predominately at the mid and lower elevations and on southerly aspects in the forested zone. These forests are generally limited by low water availability and are often subject to drought. This group primarily consists of ponderosa pine as the cover type, but Douglas fir is also common at the upper elevations and moister sites (Quigley and Arbelbide 1997).

Additionally, while not recognized as a specific forest community, stands of western juniper occur sporadically throughout the low elevation western and northern portions of the subbasin (Kagan et al. 2000).

Historically (c. 1850), the majority of the subbasin was covered primarily by grasslands (78%) and shrub-steppe communities (10%) (IBIS 2004). While much of these communities have been replaced by agriculture, some tracts of these communities still exist (Figure 8). Much of the remaining grasslands are “needle-and-thread” grasslands (composed of *Agropyron dasystachyum, A. spiciatum, Poa secunda,* and *Stipa comata*) and cheatgrass-dominated grasslands (Kagan et al. 2000). Shrub-steppe communities dominate the drier sections of the subbasin, and species include big sagebrush and Sandberg’s bluegrass, and in moister sections, Idaho fescue (Clarke and Bryce 1997).

Riparian areas contain the most biologically diverse habitats in the subbasin because of their variety of structural features (including live and dead vegetation) and proximity to water bodies. This combination of features provides a wide array of habitats that support more species than any other land cover type (Quigley and Arbelbide 1997). Common deciduous trees and shrubs in riparian areas include cottonwood, alder, willow, red-osier dogwood, common chokecherry, and black hawthorn (USFS and BLM 2000; Wooster and DeBano 2003).

3.1.1.6 Land Use and Population

The majority of land in Umatilla and Morrow Counties is used for agricultural purposes, as defined by the proportion of the total area designated as cropland, pasture, and rangeland (Figure 9). Cropland, both dryland and irrigated, comprise about 39% of the Umatilla/Willow subbasin (IBIS 2004). Approximately 73% of the cropland in the subbasin is dryland and 27% is irrigated (personal communication: R. Denny, Umatilla County SWCD, March, 2004). Rangeland and range-forest transition areas account for 42% of land cover, forest accounts for approximately 14%, and urban and developed areas account for approximately 1% (Umatilla SWCD 2001, IBIS 2004).

According to the US Census Bureau’s estimate for 2000, 70,548 people live in Umatilla County, resulting in a density of 21.9 people per square mile (US Census Bureau 2002). The majority of these people (51.2%) live in rural areas and towns of less than 2,000 people. In 2000, approximately 48.8% of Umatilla County’s population lived in the three largest towns, Pendleton (population 16,354), Hermiston (population 13,154), and Umatilla (population of 4,978). These three towns are all found along the mainstem of the Umatilla River (Figure 9). In Morrow County the Census Bureau’s 2000 estimate for population size was 10,995, resulting in a density of only 5.4 people per square mile (US Census Bureau 2002). Only one town in Morrow County, Boardman (population 2,855), has a population larger than 2000. This town’s population represents 26% of Morrow County’s entire population (US Census Bureau 2002).

The Bureau of Indian Affairs (BIA) estimated the total resident Native American population on or near the Confederated Tribes of the Umatilla Indian Reservation (CTUIR) at more than 2,400 in 1998 (including Native Americans enrolled with other Tribes). The

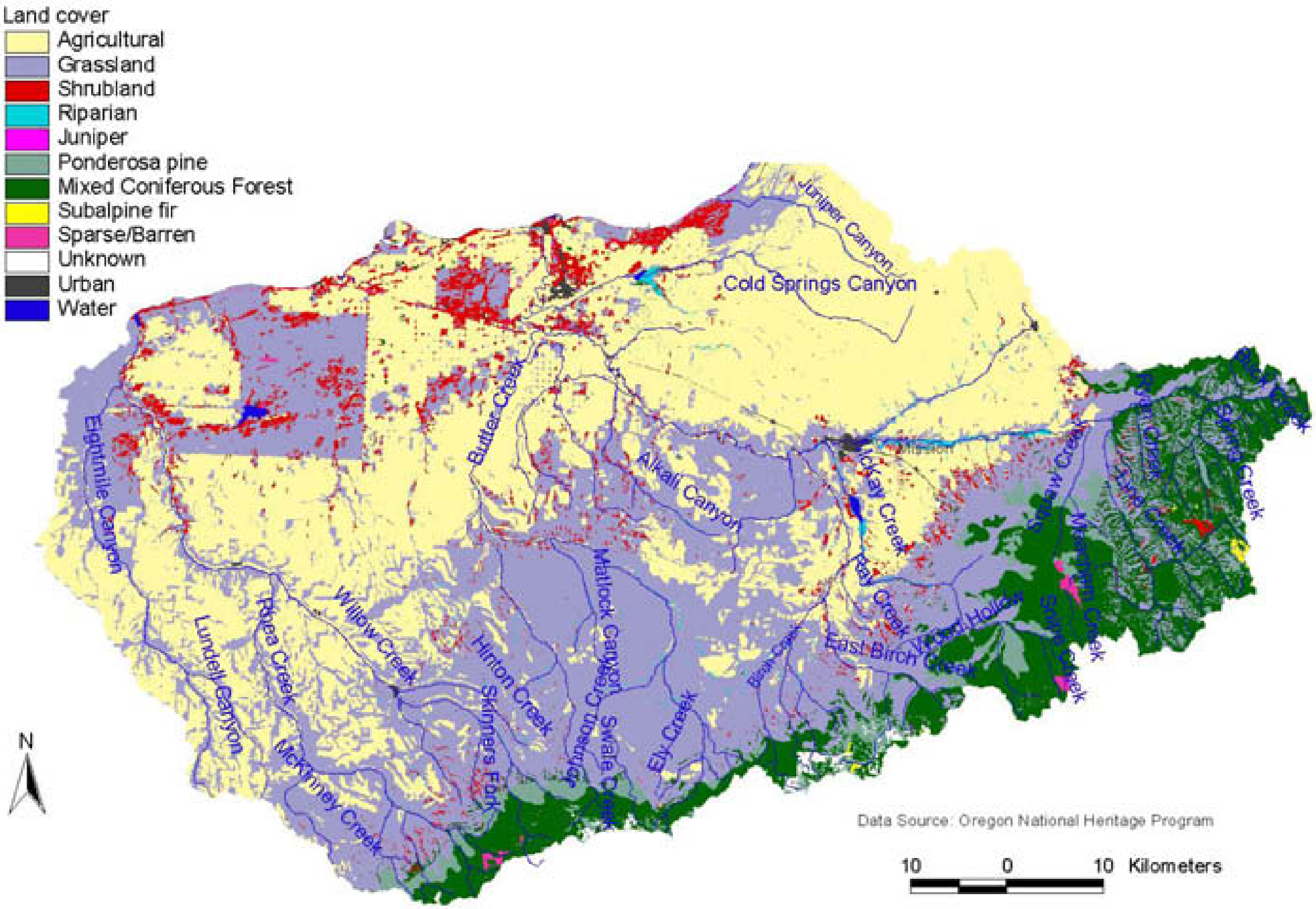


Figure 8. Land cover types occurring throughout the Umatilla/Willow subbasin.

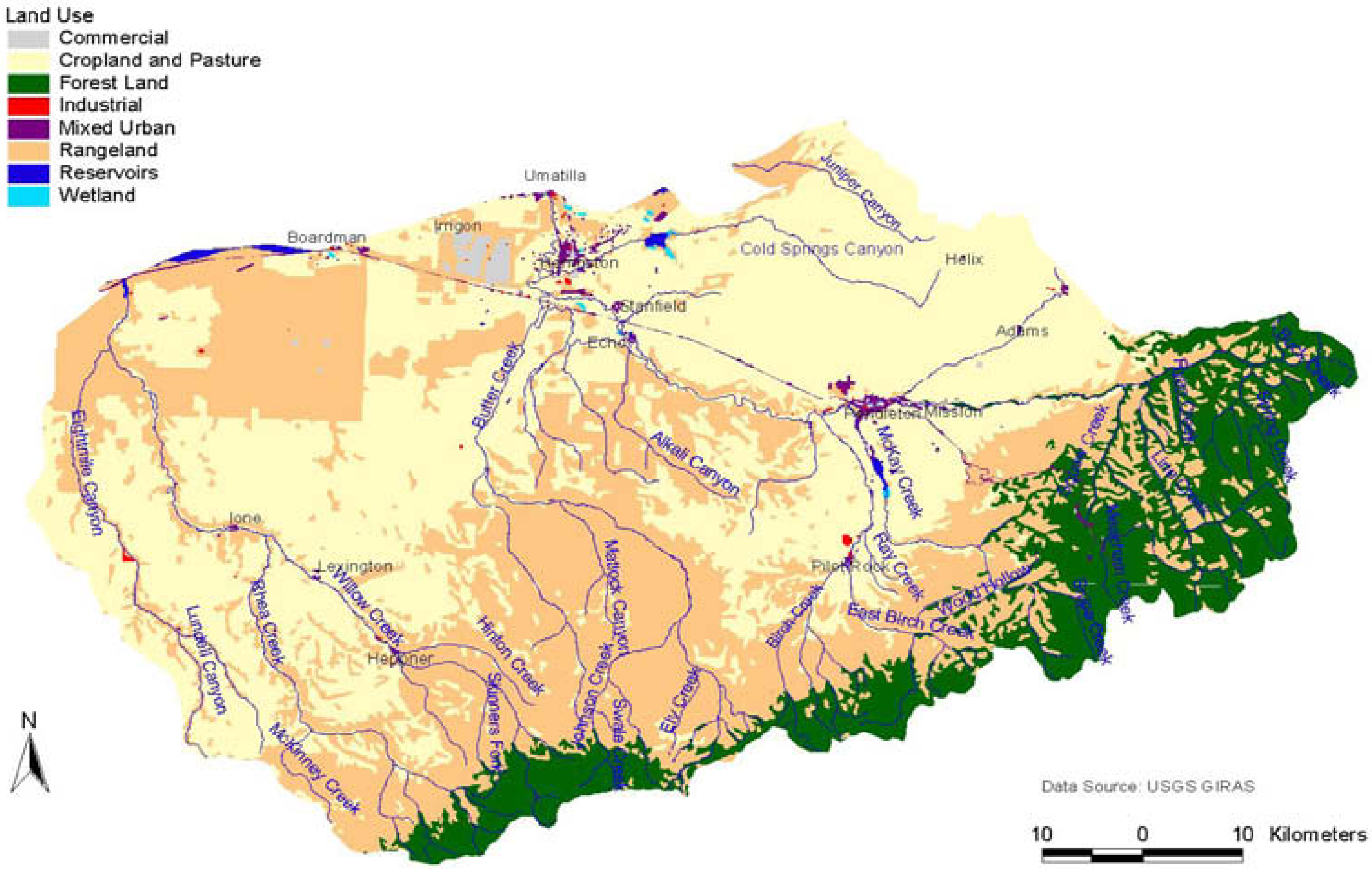


Figure 9. Land use in the Umatilla/Willow subbasin.

August 1998 CTUIR membership numbered 2,140 members living on and off Reservation lands. The Reservation is also home to about 1,700 non-Native Americans.

3.1.1.7 Economy

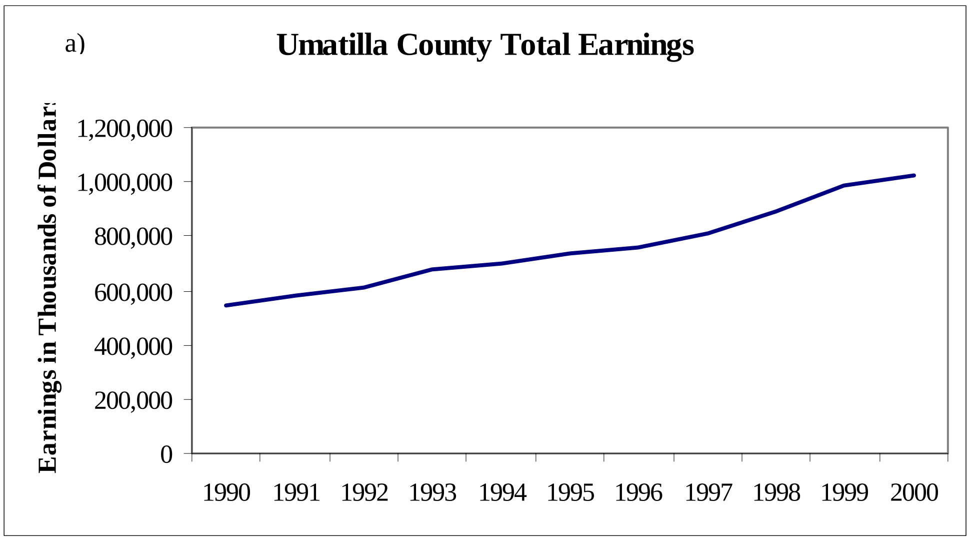
The economies of Umatilla and Morrow Counties, as measured by total earnings, rose steadily from 1990 to 2000 (Figure 10). Earnings from government sources made up the largest component of the economy in Umatilla County from 1990-2000 (Figure 11a). Manufacturing (especially of lumber and wood products and food processing) and service industries were also important contributors to the Umatilla County economy (Figure 11a). In Morrow County, manufacturing, government, and farming were all large components of the economy throughout the same decade (Figure 11b).

In both counties, part of the service and retail industry is generated from wildland recreation opportunities available on public lands in the county, where hunting, fishing, hiking, and other outdoor activities are common. Although the dollar amount related to wildland recreation is not known, camping, hunting and fishing are all popular attractions in the area that draw in people from western Oregon, Washington, and Idaho. A large variety of animals are hunted in the area, including ducks, quail, ring-necked pheasant, black bear, mountain lion, and deer. Fishing is also very popular and the area is considered a world-class small-mouth bass fishery; walleye, sturgeon, and salmon are also part of a popular sports fishery.

Although direct earnings from farms in 2000 made up less than 5% of the economy in Umatilla County and less than 25% of the economy in Morrow County, it is important to note that significant portions of other categories, such as transportation, manufacturing, and government, are related to agricultural activities. For example, in 2001, Umatilla County farmers and ranchers employed 5,750 workers involved in the production of agricultural commodities (OSU Extension Service 2001). The total value of agriculture to the economy of Umatilla County was estimated at $685 million in 2001 (OSU Extension Service 2001). Food processing of potatoes alone accounts for $15-20 million of payroll annually in the subbasin (personal communication: D. Horneck, OSU Extension Service, February 2004).

The importance of agriculture in the Umatilla/Willow subbasin is further evident by commodity sales. In 2003, Umatilla County ranked fifth in the state in agricultural commodity sales at $200 million (OSU Extension Service 2003), with approximately 78% of gross farm sales coming from crops and 22% from animal products (Table 1). Wheat is one of the most important crops in Umatilla County, which is the largest wheat producing county in Oregon, accounting for about 1/3 of the state's production (Oregon Wheat Growers League, 2003). Cattle, potatoes, hay and vegetables are other large contributors, with alternative crops emerging as new commodities. In contrast, the timber industry has declined dramatically in recent years primarily due to harvest reductions on national forest lands (Umatilla River Subbasin Local Agricultural Water Quality Advisory Committee et al. 1999).

Morrow County is also an important agricultural center and is ranked eighth in the state for agricultural commodity sales at $180 million in 2003 (OSU Extension Service 2003). During that year, approximately 52% of gross farm sales came from livestock and 48% from crops (Table 1). In the northern irrigated part of the Willow Creek subbasin the major crops include potatoes, onions, corn and alfalfa hay, with smaller acreages planted in mint and other vegetables. In the central portion of the subbasin, dryland wheat is the major crop, and cattle are the main commodity in the southern region. Other agricultural industries of importance in Morrow County include the world's largest hybrid poplar plantation, a relatively new dairy industry with extensive facilities in the towns of Boardman and Ione, and a growing food-processing industry (Willow Creek Local Advisory Committee et al. 2003).



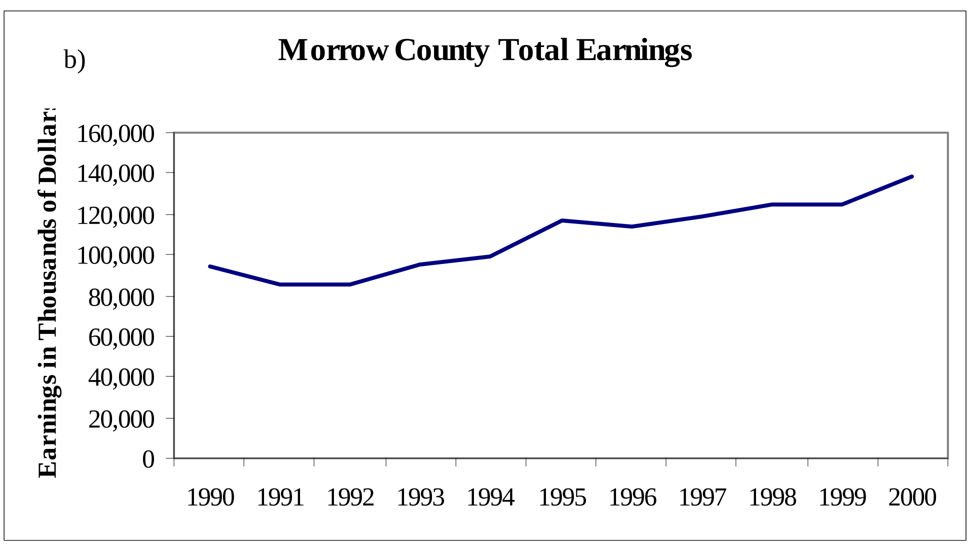
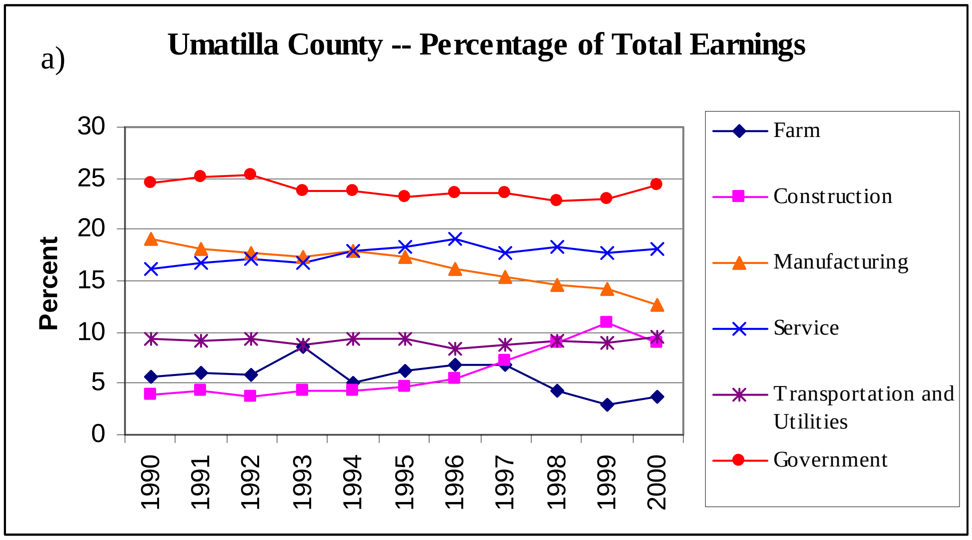


Figure 10. The total earnings of a) Umatilla and b) Morrow Counties (WSU Cooperative Extension 2002).



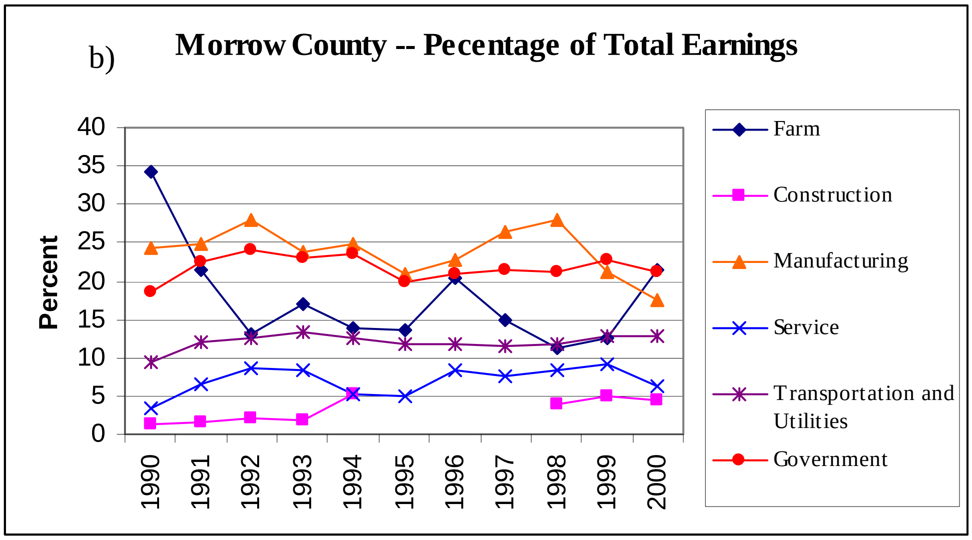


Figure 11. The proportion of total earnings for different types of industry for (a) Umatilla and (b) Morrow Counties. Several categories that make up relatively small percentages of the economy are not included in the graphs, including “Wholesale Trade”, “Finance, Insurance, and Real Estate”, and “Ag. Services, Forestry, Fishing and Other” (WSU Cooperative Extension 2002).

Table 1. Gross farm sales for Umatilla and Morrow Counties for 2002 and 2003, rounded to the nearest $1000 (OSU Extension Service 2003).

Commodity	Umatilla County		Morrow County	
	2002	2003	2002	2003
Grains	$36,919,000	$36,954,000	$10,929,000	$15,306,000
Hays and Forage	$14,658,000	$9,223,000	$8,895,000	$14,936,000
Grass and Legume Seeds	$18,374,000	$11,486,000	$2,264,000	$2,506,000
Field Crops	$43,957,000	$33,093,000	$39,827,000	$37,326,000
Tree Fruit and Nuts	$16,433,000	$20,563,000	$0	$527,000
Small Fruit and Berries	$12,000	$12,000	$0	$0
Vegetable Crops	$33,206,000	$30,978,000	$7,217,000	$12,245,000
Other Crops	$18,441,000	$13,451,000	$9,682,000	$3,785,000
All Crops	$182,000,000	$155,760,000	$78,814,000	$86,631,000
Livestock	$34,614,000	$43,530,000	$78,910,000	$93,123,000
Dairy Products	$619,000	$594,000	*	**
All Animal Products	$35,233,000	$44,124,000	$78,910,000	$93,123,000
Total Gross Sales	$217,233,000	$199,884,000	$157,724,000	$179,754,000

* Unavailable
** Not reported for 2003, but estimated value for that year is $30-35 million (personal communication: Oregon Agricultural Statistics Service, March 2004)

3.1.1.8 Land Ownership

The majority of land in the Umatilla/Willow subbasin is privately owned (Table 2; Figure 12). Approximately 11% of the drainage is managed by federal agencies, including the United States Forest Service (USFS), which manages over 70% of federally owned lands. Other landowners in the subbasin include the State of Oregon, counties, cities, and the CTUIR (CTUIR and ODFW1990).

Table 2. Land ownership and percentage of area owned in the Umatilla/Willow subbasin.

Land Ownership	Land Area Owned (acres)	Percentage of Total Area
Private Land	2,230,370	85.25
U. S. Forest Service	200,213	7.65
Bureau of Land Management	14,000	0.54
Corps of Engineers	591	0.02
Department of Defense	66,563	2.54
U. S. Fish & Wildlife Service	4,558	0.17
Umatilla Indian Reservation	96,457	3.69
State of Oregon	3,414	0.13

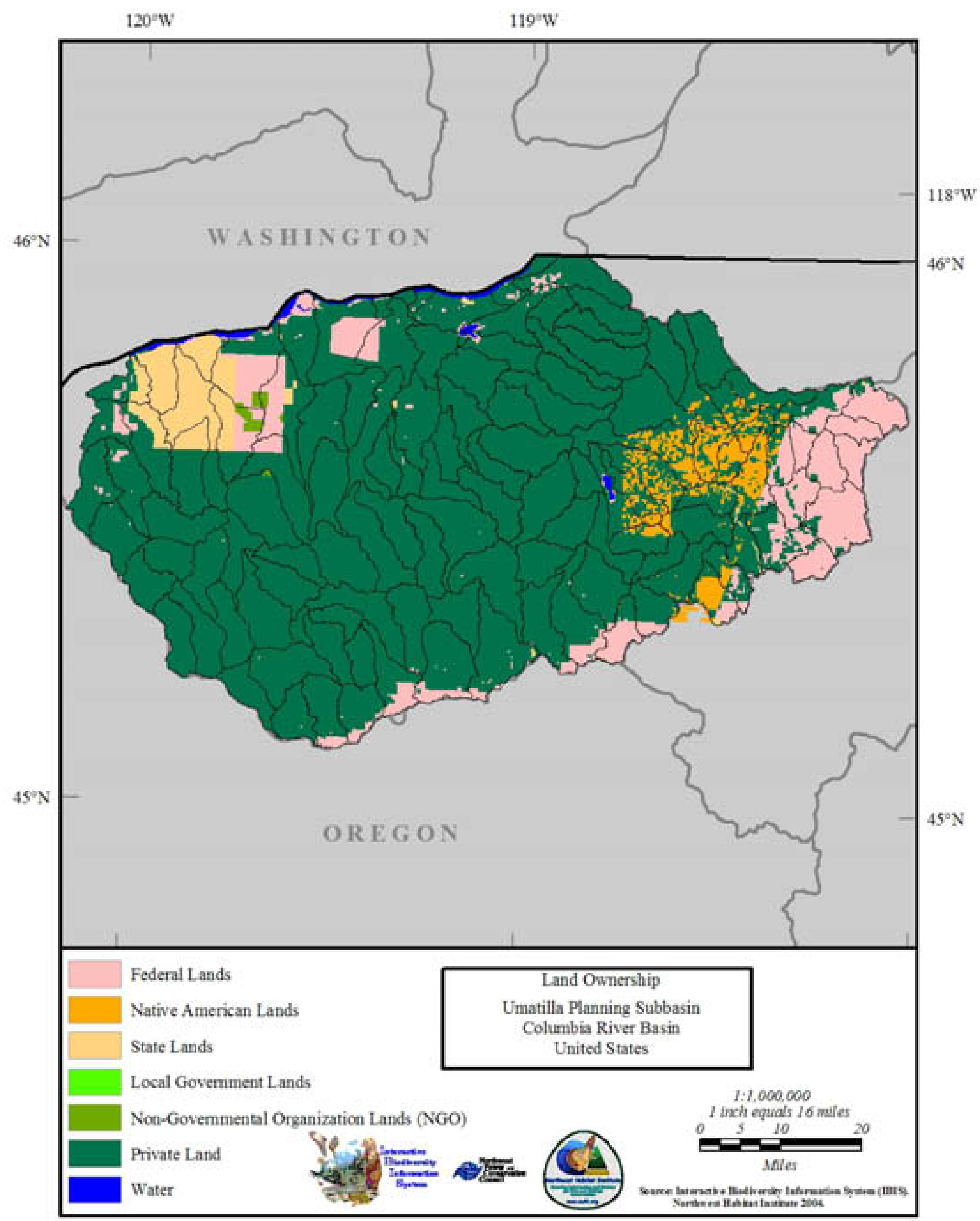


Figure 12. Land ownership in the Umatilla/Willow subbasin (IBIS 2004).

3.1.1.9 Human Influences on Aquatic and Terrestrial Environments
It is important to note that all of the human activities discussed in this section provide widespread and well-recognized benefits to Oregon's citizens, communities, and economies. However, the narrow focus of this section limits it to a discussion of how these activities influence aquatic and terrestrial environments that are important to fish and wildlife in the subbasin. Therefore, this section briefly describes how humans in the subbasin currently impact aquatic and terrestrial environments in the Umatilla/Willow subbasin through agriculture, exotic weed introduction, forest practices, livestock grazing, transportation, urbanization, and water development. The order in which these topics are presented is alphabetical, and does not reflect the magnitude of their impact. Negative impacts of these activities, their ecological effects, and the extent of their effects in the subbasin, if known, are summarized in Table 4. Positive impacts of these activities on aquatic and terrestrial environments are discussed in the text. Later sections in this document (3.1.3.2) discuss how these activities, and their effects on hydrology and ecology in the subbasin, have changed through time.

Agriculture: Agriculture is an important land use in the area, covering 39% of the Umatilla/Willow subbasin (IBIS 2004). Agriculture has affected fish and wildlife in the subbasin through water withdrawals for irrigation, stream channelization, loss of riparian vegetation, increased sediment input, and the loss of wildlife habitat and changes in hydrology associated with land conversion.

Currently, there are six major irrigation diversions in the lower Umatilla River that withdraw approximately 129,000 acre-feet on an average year (Umatilla River Subbasin Local Agricultural Water Quality Advisory Committee et al. 1999). The irrigation withdrawals dewater the river below Dillon Dam, resulting in an average daily flow over a 14-day period of less than 1 cfs (Table 3). However, return flows from these operations significantly enhance flows in this area in late summer and fall. In addition, releases from McKay Reservoir for irrigated agriculture brought about by the second phase of the Umatilla Basin Project have resulted in increased flows and decreased temperatures in the Umatilla River from Pendleton to Echo from June through September (see discussion below on Water Development and Section 3.1.3.2 for more details on the benefits of water exchange projects in the subbasin).

Irrigation in the Willow Creek subbasin can also have extensive effects on instream flow. For example, the upper Willow Creek drainage has a total annual flow of approximately 30,000 acre-feet; however, by RM 4, total annual flow is reduced to an estimated 23,000 acre-feet due to extensive irrigation withdrawals and stream channel losses (Willow Creek Local Advisory Committee et al. 2003). The effect of water withdrawals in summer is particularly significant. Willow Creek below Ione is almost entirely dry from late June until early September as irrigation diversions during summer low flow periods results in the total diversion of flow (personal communication: K. Ramsey, USFS, January 2004). The few pools that remain provide a limited and fragmented habitat for aquatic species in the summer.

Another impact resulting from use of water by agriculture is an increase in summer water temperatures, which further decreases the availability of the lower river to salmon as habitat. Importantly, many other factors besides agriculture influence summer water temperatures in the Umatilla/Willow subbasin (e.g., see Table 4 and Section 3.1.2.2). Summer water temperatures in the lower Umatilla River frequently exceed the incipient lethal limit for salmonids of 21°C (ODEQ et al. 2001; Contor 2003). However, as noted above, releases from McKay Reservoir from June to September have a beneficial impact on temperature and flow from June through September between Pendleton and Echo.

Table 3. Low-flow statistics for the Umatilla River below McKay Creek (ODEQ et al. 2001).

Return Period	**Umatilla River at Yoakum (cfs)**			**Umatilla River near Umatilla**		
	1-Day	**7-Day**	**14-Day**	**1-Day**	**7-Day**	**14-Day**
1-year	129.8	138.1	143.7	0.2	0.7	0.7
2-year	36.2	38.8	40.9	0.1	0.4	0.6
5-year	25.7	27.8	29.5	0.0	0.1	0.3
10-year	22.0	24.0	25.4	0.0	0.1	0.3
25-year	19.0	20.9	22.2	0.0	0.1	0.2
50-year	17.4	19.2	20.4	0.0	0.1	0.2
100-year	16.2	17.9	19.0	0.0	0.1	0.2

Streams are often channelized in agricultural fields to prevent flooding of fields and natural channel movement into fields. Channelization has a number of detrimental effects on stream and riparian ecosystems. It compresses the period of water conveyance, makes streams flashier, and increases and concentrates the energy of the water within the channel itself (instead of dissipating that energy across the floodplain). This increased energy can accelerate erosion of the stream channel, leading to channel incision and gully creation (NRC 2002). Channelization influences stream reaches downstream of channelized areas by creating higher flood peaks and delivering greater loads of sediment and nutrients (NRC 2002). Channelization also destroys riparian areas either directly, through human activity when the channel is being created, or indirectly, by decreasing subsurface water exchange with riparian areas and lowering the water table (NRC 2002). The decrease in subsurface water exchange and the lowering of the water table not only impacts riparian vegetation, but has an impact on agriculture by decreasing the recharge of shallow groundwater aquifers that provide well-water for many rural residents (personal communication: G. Reed, OSU, April 2004). Channelization can also reduce the exchange of water between the hyporheic zone and the stream channel. This exchange is beneficial in moderating temperatures in the stream. Reduced exchange results in higher temperatures in the summer and lower temperatures in the winter (ODEQ et al. 2001). Finally, channelization greatly decreases winter habitat (e.g., braided channels, sloughs) for juvenile salmon and steelhead. This habitat is very important for overwinter survival and growth of juvenile salmon (Swales et al. 1986, 1988) and the removal of this type of habitat results in severe reductions in the number of overwintering juvenile salmon (Tschaplinski and Hartman 1983). The loss of this type of habitat in the Umatilla River and its tributaries is thought to be one of the most significant causes of the reduction in naturally surviving salmonid and steehead (personal communication: C. Contor, CTUIR, April 2004).

Stream sediment derived from agricultural practices that result in erosion-causing runoff is another important impact of agriculture in the Umatilla/Willow subbasin. Dryland crop erosion problems stem from traditional winter wheat/summer fallow operations. Rasmussen et al. (1993) suggest that the winter wheat/summer fallow monoculture cropping system of Oregon's Columbia basin in 9" to 20" rainfall zones is not sustainable, either biologically or economically. According to the USDA Agricultural Research Service (ARS) and Natural Resources Conservation Service (NRCS), this cropping system is subject to significant soil erosion problems, especially when rain falls on frozen soils. Summer fallow has decreased the soil organic matter to half or less of its original levels under native grassland, contributing to erosion and crusting problems after seeding dryland crops. However, the use of crop residue management practices such as direct seeding and reduced tillage can virtually eliminate erosion from traditional farming systems (personal communications: T. Straughan, ODA, September 2002; T. Bennett, NRCS, January 2004). While some form of residue management is widely used, especially on shallower soils and wind erosion prone areas, direct seeding is not yet widely accepted in the area as an economically viable alternative. Other programs, such as the Conservation Reserve Program (CRP), help decrease erosion by reducing the amount of land under cultivation by planting to permanent vegetation that is similar to native vegetation (see Sections 3.1.3.2 and 4.3).

The conversion of large areas of native vegetation to croplands has resulted in a significant loss of wildlife habitat in the Umatilla/Willow subbasin. Shrub-steppe and grasslands habitats have been the most heavily affected (see Sections 3.1.3.2 and 3.2.4.2 for more details). The conversion of native vegetation to cropland has also changed the hydrology of the subbasin, beyond those effects associated with irrigation and channelization. For example, the conversion of large tracts of land into winter wheat/summer fallow crop systems results in slower infiltration into the ground and greater runoff of water into streams during precipitation events.

Exotic Weed Introduction: The term "exotic weeds" in this plan refers specifically to non-native, invasive plants. The spread of exotic weeds is facilitated by humans, either intentionally (e.g., planting exotic ornamental plants on private property, seeding exotic grasses on public lands to prevent erosion) or unintentionally (e.g., accidental transfer of exotic seeds or other plant material though human travel, livestock movement, or in nursery products). Regardless of the method of introduction, the problem of exotic weeds in the Umatilla/Willow subbasin is as prevalent and troublesome as elsewhere in Oregon and the United States. For example, Kagan et al. (2000) reported that all shrub-steppe and grassland habitats in the lower Umatilla/Willow subbasin contained well-established populations of cheatgrass and/or medusahead. Another study conducted during the summer of 2001 in the floodplain of the lower 80 miles of the Umatilla River revealed that approximately 44% of the plant species were exotic (Adamus et al. 2002). A study of 20 riparian sites along streams in the Patawa-Tutuilla watershed (a subwatershed of the Umatilla River watershed) found 1) that all sites had exotic weeds, 2) that 35 of the 52 herbaceous species found in the study were exotic, and 3) that the average percent coverage of herbaceous exotic weeds in these riparian areas was over 70% (Wooster and DeBano 2003).

Several exotic plant species are particularly problematic in the subbasin. For example, knapweed and yellow starthistle, natives of the Mediterranean, are rapidly increasing in the subbasin because of the similarities in climate between the two locations (Quigley and Arbelbide 1997). Both are widespread and rapidly invade areas that have been disturbed to replace native plant species. Other serious exotic species includes rush skeletonweed, spikeweed, medusahead, and perennial pepperweed. Russian olive is a major problem in wet meadows and riparian areas to which it has escaped from residential plantings. Other widespread exotic species identified in a recent study in the Umatilla floodplain include desert false indigo, reed canarygrass, Himalayan blackberry, and ripgut brome (Adamus et al. 2002). In the Patawa-Tutuilla watershed, cheatgrass, poison hemlock, and common teasel were found to be the most prevalent exotic weeds (Wooster and DeBano 2003).

The invasion of cheatgrass into shrub-steppe habitats is especially problematic as it increases the frequency and severity of range fires (Paige and Ritter 1999). This change in fire regime is a result of cheatgrass growing at much higher densities compared to native vegetation (providing an unbroken flammable medium to carry fire), its property of drying out early in the season, and its ability to quickly reestablish itself after fire. In most instances, cheatgrass-dominated shrub-steppe results in complete conversion to cheatgrass and other exotic weeds once the area burns. Sagebrush and other native shrubs take several years to decades to reestablish themselves after these intense fires. Since the cheatgrass returns quickly, and may burn as frequently as every five years, native shrubs have no opportunity to reestablish. The reestablishment of sagebrush in cheatgrass dominated rangelands is a major problem throughout the sagebrush zone of the Interior Western U.S., and no solution to the problem has been found. To date, the only method found for reestablishment is to plant individual sagebrush plants by hand, something that is not practical for any but the smallest areas.

Exotic weed invasions not only affect native plants species, but can also impact terrestrial wildlife in the Umatilla/Willow subbasin. Loss of native plant cover can reduce the suitability of habitat available to wildlife (Quigley and Arbelbide 1997, Dobler et al. 1996) (see Section 3.4.2 for effects on specific wildlife species). Exotic weeds may also affect aquatic food webs of streams. For example, leaf litter derived from exotic plants is less palatable to aquatic invertebrate shredders than leaf litter derived from native plants in Australia (Schulze and Walker 1997), although studies examining this effect in the U.S. are lacking.

The problem of exotic weed invasion may be less severe in forested headwaters. For example, a recent study in the headwaters of the Umatilla River found that between 87-98% of plant species encountered were native, although the extent of acreage occupied by exotic weeds was not determined (Umatilla National Forest 2001).

Forestry Practices: Harvesting of timber occurs primarily along the North and South Forks of the Umatilla River, accounting for 32% of timber cut on the forest, and along Meacham Creek, which constitutes an estimated 18% of the harvest (Umatilla National Forest 2001). This harvest has occurred on only 10% of the forested land since the early 1960s (Umatilla National Forest, 2001). Most of the timber sale activity occurs on slopes less than 30% (Umatilla National Forest 2001). The Umatilla National Forest has designated a large area surrounding the North Fork of the Umatilla River as a Wilderness Area, precluding it from further harvest activities.

Two subwatersheds within the National Forest that are designated as areas of concern due to extensive clearcutting (greater than 15% of the forested area) are Spring Creek (28.2% clearcut) and Upper Meacham/Wilbur subwatersheds (28.6% clearcut). Several other subwatersheds are of concern due to high road densities (over 2.0 miles/square mile), including Upper North Fork of the Umatilla, Buck Creek, Thomas Creek, Spring Creek, Shimmiehorn Creek, Upper South Fork of the Umatilla, East Meacham Creek and Owsley Creek (Umatilla National Forest 2001).

Harvesting of timber also occurs in Morrow County, with some extensive logging occurring on private property in the headwaters of Rhea Creek within the last year (personal communication: K. Ramsey, USFS, January 2004). Although Oregon forest practices are being followed, these are less stringent than USFS practices, and the harvest may affect water quality in Rhea Creek (personal communication: K. Ramsey, USFS, January 2004).

Intact forests serve several important ecological functions. They retard runoff during heavy rains and periods of rapid melting of snows, and increase the amount of water that percolates into the ground. By decreasing and desynchronizing snowmelt and runoff, and increasing percolation, forested areas lower flood levels and raise low water levels (Whitaker 1947). Deforestation, both past and present, has likely altered runoff rates by reducing riparian and water storage capacities (Shaw and Sexton 2000). These effects are particularly severe in steep headwater areas.

Livestock Grazing: Rangeland and range-forest transition are common in the Umatilla/Willow subbasin (42%). Although horses and sheep were the main type of livestock grazed in the subbasin historically (see Section 3.1.3.2), cattle now comprise the majority of livestock in the area. Livestock grazing has impacted the Umatilla/Willow subbasin by changing vegetation composition, decreasing the amount of native vegetation, and reducing vegetative cover, which leads to increased water and wind erosion (Shelford and Hanson 1947). Cattle, horses, and sheep can also destroy riparian vegetation and destabilize stream banks if allowed to forage in riparian zones (Waters 1995).

Transportation: The construction of transportation corridors, primarily paved and gravel roads, and railroads, is another human activity that has impacted rivers and streams in the Umatilla/Willow subbasin. Transportation corridors are often built along waterways, and this is true for both the Umatilla and Willow Creek subbasin. For example, both State Highway 74 and the Union Pacific Railroad run almost the entire length of Willow Creek (from near the mouth to Heppner). Similarly, asphalt county roads and the Union Pacific Railroad run adjacent to the Umatilla River mainstem from near its mouth to Meacham Creek (RM 79). Roads and railroads are also found along the great majority of the length of two of the Umatilla's tributaries, Wildhorse Creek and Meacham Creek. Abandoned railroads also impact streams in the subbasin. For example, [0]Union Pacific and Northern Pacific had railroads running out of Pendleton to Adams/Athena and Helix /East Juniper Canyon respectively until 1978. The legacy of those road-beds is still a major influence on Wildhorse Creek and its tributaries (personal communication: J. Williams, USDA-ARS, January 2004).

Four important impacts of transportation corridors on fish and wildlife are loss of riparian vegetation, increased water temperatures, increased surface water run-off into stream channels, and increased flashiness in flow followed by reduced low flows. Loss of riparian vegetation occurs during the construction of transportation corridors and re-growth is often cut back to prevent vegetation from interfering with the use of the corridors. Increased water temperature occurs as a result of the decrease in shading from the riparian vegetation removal (NRC 2002). Many transportation surfaces are impervious to water and thus increase surface run-off (which would normally be absorbed by the soil), making streams more prone to flooding. Sediment loads into streams can be increased by erosion at construction sites, failure of embankments and cut slopes, and inadequately designed drainage ditches or erosion caused by funneling hillside runoff through culverts (Swanson et al. 1987; Waters 1995). Channelized streams are also very efficient conveyors of sediment (NRC 2002).

Urbanization: Although only 1% of the land in the Umatilla/Willow subbasin has been urbanized (IBIS 2004), cities and towns have impacted the aquatic and terrestrial environment of the subbasin. These impacts include changes in streamflow, water quality, channel morphology, and available fish and wildlife habitat.

Flow is influenced by water withdrawals. Pendleton has historically diverted approximately 3.8 cfs of flow between June and December from a series of infiltration galleries, commonly known as Thornhollow Springs, located approximately 17 miles east of the city near the Umatilla River. During the lowest flow conditions of late summer, this withdrawal represents an approximately 10% diversion of flow of the Umatilla River. However, the City of Pendleton is currently undertaking a series of water supply development projects that will improve both instream flows and temperature in the Umatilla River. These projects are described in greater detail in Section 4.3.

Urbanization can also impact water quality in a number of ways. Runoff from developed areas in towns and cities can negatively impact water quality when pollutants are conveyed into stream systems. The Umatilla River Basin WQMP (ODEQ 2001) is designed to address this issue, and the City of Pendleton has taken steps to reduce the runoff of pollutants into streams and riparian areas (see Section 4.3 for more detail). Effluent from wastewater treatment plants can also affect water quality. The release of effluents can increase or decrease temperatures and elevate concentrations of ammonia and chlorine in streams and rivers. For example, higher levels of ammonia have been measured in the lower Umatilla River from 1996 to 1999 during the summer low flow months when the Hermiston wastewater treatment plant discharges effluent into the river (ODEQ 2001); the median ammonia concentration in the river downstream of the discharge was 1.29 mg/L higher than the upstream median concentration. National Pollutant Discharge Elimination System permits limit the concentration of ammonia and chlorine below toxic levels. New permit limits have been established to address the related water quality issues at the Hermiston and Pendleton wastewater treatment plants. Notably, high levels of fecal coliform that have been recorded in the Umatilla River in Pendleton are not attributable to the release of wastewater effluent into the river. Regular, required monitoring of effluent at the Pendleton wastewater treatment plant shows no evidence of elevated levels of fecal coliform (personal communication: S. Lawrence, City of Pendleton, February 2004). The cause of these elevated levels of fecal coliform is unclear, although non-point sources are suspected.

Dikes, levees, and rip-rapped banks created to protect homes, farm buildings, and roads within the floodplain have straightened and confined stream channels and reduced riparian vegetation in many parts of the subbasin, leading to a decline in available fish and wildlife habitat (Contor et al. 1997; Shaw and Sexton 2003). For example, the majority of the south bank of the Umatilla River in Pendleton is levied. Uplands are also affected by urbanization; approximately 1% of wildlife habitat in the Umatilla/Willow subbasin has been lost to land conversion through urban development.

Water Development: Three general types of water development projects impact aquatic and terrestrial environments in the Umatilla/Willow subbasin: impoundments, irrigation diversions, and water exchange projects. The largest impoundment projects in the Umatilla subbasin are McKay Reservoir, with a design capacity of 73,800 acre-feet, and Cold Springs Reservoir, with a design capacity of 50,000 acre-feet (ODEQ et al. 2001). These reservoirs function to supply irrigation flows to three irrigation districts (Stanfield, Westland, and Hermiston Irrigation Districts) and to some individuals during high-demand summer months (personal communication: M. Ladd, OWRD, January 2004). The impacts of irrigation diversions on water temperature and flow are discussed in the preceding discussion on agriculture in this section.

Two phases of a water exchange program that are part of the Umatilla Basin Project (described in more detail in Section 3.1.3.2) have helped to restore stream flows that were reduced as a result of these impoundments and diversions. Phase I of the project involves pumping water (up to 140 cfs) from the Columbia River into the West Extension Irrigation District system, to offset diversion of Umatilla River water when flows in that river drop below target values. Phase II involves exchanging up to 240 cfs of Umatilla River and McKay Reservoir water for Columbia River water for use by the Stanfield and Hermiston Irrigation Districts. This results in water that had historically been diverted from live flow and from McKay Reservoir releases being retained for instream uses. As a result, in 2003, approximately 65,000 acre-feet of water were used to maintain instream flow in the Umatilla River below McKay Creek (personal communication: M. Ladd, OWRD, January 2004).

While the water exchanges associated with the Umatilla Basin Project do not increase flows year-round, they do increase flows during critical times for salmon and steelhead adult returns and juvenile outmigration (see Section 3.1.3.2 for more detail). In addition, releases of water from McKay Reservoir during summer generally positively impact temperatures of reaches of the Umatilla River below the McKay Creek confluence (RM 50.5) (Figure 13). Surveys determined that hypolimnetic releases of cool water from the reservoir during early summer months kept temperatures suitable for salmonids in areas between the McKay Creek confluence and Westland Dam (RM 27.2) (Contor et al. 1997). However, McKay Reservoir releases for fish are not continuous during the summer, and water temperatures in the river can become extreme at times. In addition, warmer epilimnetic waters can be discharged upon the depletion of the hypolimnion and can contribute to unsuitable habitat conditions for salmonids (Contor et al. 1997).

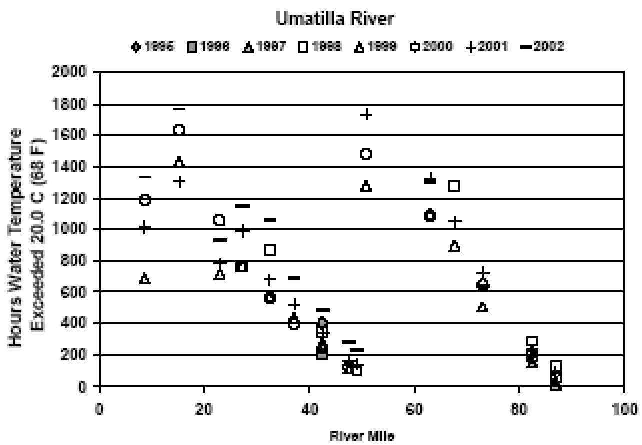


Figure 13. The number of hours water temperatures exceeded 20°C during June-September, 1995-2002, in the Umatilla River at selected sites from RM 8-87 (Contor 2003).

Willow Creek subbasin also has several water development projects that affect aquatic and terrestrial habitats. Willow Creek Reservoir, with a design capacity of 14,000 acre-feet, was created when the USCOE constructed a 160-ft high dam just upstream of Heppner in an effort to control flash flood events, which in the past have claimed both lives and property. The construction of the reservoir has altered the hydrology of lower Willow Creek by eliminating high peak flows caused by snowmelt and cloudburst events and providing more constant flows during late winter and spring (Willow Creek Local Advisory Committee et al. 2003). Controlled releases by USCOE from the reservoir, which often result in extended periods of greater than bankfull flows when the ground is already saturated from spring rain events, maintains the channelized morphology of Willow Creek (Willow Creek Local Advisory Committee et al. 2003; personal communication: K. Ramsey, USFS, January 2004). Aquatic environments in Willow Creek subbasin are also substantially affected by irrigation diversions, as described in the preceding discussion on agriculture in this section.

Table 4. Negative impacts on the aquatic and terrestrial environments in the Umatilla/Willow subbasin resulting from agriculture, forestry practices, livestock grazing, transportation corridors, and urbanization. The order of listed practices is alphabetical and does not reflect the magnitude of their impact.

Impact and **Practice Causing Impact**	**Ecological Effect**	**Examples of Extent** **in Umatilla/Willow Subbasin**
Impact: Stream Channelization **Practices Causing Impact:** • Agriculture • Transportation Corridors • Urbanization	• Increased flood frequency • Increased erosion of stream channel, leading to "gully" channels • Increased sediment deposition downstream • Increased water temperature • Channel is separated from floodplain, destroying riparian vegetation • Loss of complexity/habitat for aquatic life • Loss of exchanges between the hyporheic zone and river flow with a subsequent increase of summer water temperatures and decrease in winter water temperatures • Loss of winter habitat for juvenile salmon and steelhead	• Large portions of the mainstem Umatilla and its tributaries have been levied or channelized • Large sections of Willow Creek below the Willow Creek Reservoir (RM 55.5) have been channelized[1] .
Impact: Reduced Instream Water Volume **Practices Causing Impact:** • Agriculture • Urbanization	• Decreased habitat for fish • Increased water temperatures • Decreased water quality (dissolved oxygen, pH, bacteria)	• Average summer low flow from Three Mile Dam (RM 4) to mouth of Umatilla River is 1cfs compared to 143 cfs above all diversions (RM 32)[2] • total annual flow of upper Willow Creek drainage is ~ 30,000 acre-feet, but reduced to 23,000 acre-feet by RM 4[1]
Impact: Riparian Vegetation Loss **Practice Causing Impact:** • Agriculture • Forestry • Livestock Grazing • Transportation Corridors • Urbanization	• Habitat lost for wildlife • Increased water temperature through loss of shading • Disrupts aquatic ecosystems through loss of woody debris and food base (organic inputs)	• 87% or greater loss of bottomland hardwood and willow riparian communities in the lower Umatilla/Willow subbasin[7] • Approximately 70% of mainstem Umatilla and its tributaries would benefit from riparian restoration[3]

Table 4 (continued). Negative impacts on the aquatic and terrestrial environments in the Umatilla/Willow subbasin resulting from agriculture, forestry practices, livestock grazing, transportation corridors, and urbanization. The order of listed practices is alphabetical and does not reflect the magnitude of their impact.

Impact and Practice Causing Impact	Ecological Effect	Examples of Extent in Umatilla/Willow Subbasin
Impact: Increased Erosion/Sedimentation into streams **Practice Causing Impact:** • Agriculture • Forestry • Livestock Grazing • Transportation Corridors • Water Development	• Loss of quality spawning sites for salmonids • Loss of macroinvertebrate taxa that are potentially important food sources • Decreased water quality • Loss of concealment cover for immature salmonids when interstitial spaces between gravel and cobble fill with sediment	• Umatilla mainstem: turbidity exceeded 30 NTUs over 48 hours (TMDL standard) 7 and 9 times in water years 1999-2000 and 2000-2001, respectively[5] • Numerous tributaries of the Umatilla River §303(d) listed for sediment (see Table 9) • Meacham Creek: substrate embeddedness greater in managed areas than in reference areas[4] • Significant erosion problems during high flow below Willow Creek Reservoir (RM 55.5)[1]
Impact: High Water Temperatures **Practices Causing Impact:** • Agriculture • Irrigation Diversions • Forestry • Livestock Grazing • Transportation Corridors • Urbanization	• Direct impact on salmonid health	• 287 stream miles in Umatilla subbasin and Willow Creek from mouth to Willow Creek Lake on 1998 303(d) list[6]

Table 4 (continued). Negative impacts on the aquatic and terrestrial environments in the Umatilla/Willow subbasin resulting from agriculture, forestry practices, livestock grazing, transportation corridors, and urbanization. The order of listed practices is alphabetical and does not reflect the magnitude of their impact.

Impact and Practice Causing Impact	Ecological Effect	Examples of Extent in Umatilla/Willow Subbasin
Impact: Land Conversions **Practices Causing Impact:** • Agriculture • Livestock Grazing • Reservoir Development • Transportation Corridors • Urbanization	• Loss of wildlife habitat • Loss of riparian vegetation (see above)	• Approximately 53% of grassland and shrub-steppe in Umatilla/Willow subbasin converted to agriculture and rangeland[7] • Wetlands: in a 6 mile stretch of the upper Umatilla River (RM 72.5 to 78.5), a total of 420 of 1,330 acres (35%) of the floodplain was "stranded" or lost due to the construction of dikes, railways, and roadway[8]. In the Echo/Umatilla Meadows complex of the lower Umatilla River, approximately 5,370 of 6,340 acres (90%) of the meadow area has been stranded or cut off from the floodplain due to conversion to farmland, construction of transportation routes, and channel and dike construction.[8]

Sources:
1 Willow Creek Local Advisory Committee et al. 2003
2 ODEQ et al. 2001
3 Reported in CTUIR and ODFW 1990, p. 10, which states this estimate originated from an ODFW inventory of 422 miles of streams in the Umatilla subbasin.
4 Umatilla National Forest 2001
5 Shaw and Sexton 2003
6 ODEQ 2003
7 Kagan et al. 2000: based on comparisons of General Land Office surveyor reports c. 1850 with current cover maps generated by Kagan et al.
8 CTUIR 1997, p. 6: based on analyses of aerial photos

In addition to their effect on instream flow and temperature, water development projects can also impact aquatic environments by introducing passage barriers to migrating fish and by fragmenting aquatic habitats. Passage problems on the mainstem Umatilla River from the construction of diversion dams have been largely mitigated, as have many passage problems on tributaries; however, a number of significant passage barriers remain, particularly in Birch, Butter, and Willow Creeks. Flows in Willow Creek are only substantial enough in the spring to allow passage of remnant mid-Columbia steelhead over the diversion dams located downstream of Heppner (personal communication: K. Ramsey, USFS, January 2004). In addition, unscreened water diversions can also have a substantial impact on anadromous fish. Although all known gravity feed diversions in the anadromous portion of the Umatilla subbasin are screened, it is not known to what extent pump diversions have been screened in the anadromous portion of the subbasin. In addition, although the total number of unscreened diversions in Butter and Willow Creeks is unknown, several diversions on Willow Creek are known to lack screens (personal communication: K. Ramsey, USFS, January 2004).

Further details on the development of water and trends in their effects on the hydrology and ecology of the Umatilla\Willow subbasin are found in Section 3.1.3.2.

3.1.2 Subbasin Existing Water Resources

3.1.2.1 Watershed Hydrography and Hydrologic Regime

Originating at nearly 6,000 feet in elevation, the Umatilla River headwaters flow out of the Blue Mountains through narrow, well-defined canyons. After leaving the mountains, the North and South Fork join to form the mainstem, an 89 mile reach of river that flows through a series of broad valleys that drain low rolling lands (USCOE 1997, ODEQ et al. 2001). The mainstem Umatilla River has eight main tributaries: the North and South Forks of the Umatilla River and Meacham Creek in the upper subbasin; Wildhorse, Tutuilla, McKay and Birch Creeks in the mid subbasin; and Butter Creek in the lower subbasin (Figure 14; Table 5).

Except for Wildhorse Creek, the main tributaries of the Umatilla River drain the Blue Mountains and enter the Umatilla River from the south. Wildhorse Creek drains the divide between the Umatilla River and the Walla Walla River to the north. The North and South Forks of the Umatilla River and Meacham Creek account for approximately 14% of the Umatilla River subbasin drainage area, yet supply 40-50% of the average flow to the Umatilla River. At its confluence with the Umatilla River, Meacham Creek effectively doubles the water supply of the mainstem. For example, average discharge of the mainstem directly upstream of Meacham Creek in 2000 was 212 cfs and discharge of Meacham Creek was 192 cfs. During the same year, average discharge near the mouth of the Umatilla River was 525 cfs.

Besides these main tributaries there are many smaller tributaries of the Umatilla River (Figure 14). Deep, incised channels characterize most of these creeks particularly in the plateau area, and most are intermittent, carrying water only during periods of snowmelt or sustained rainfall.

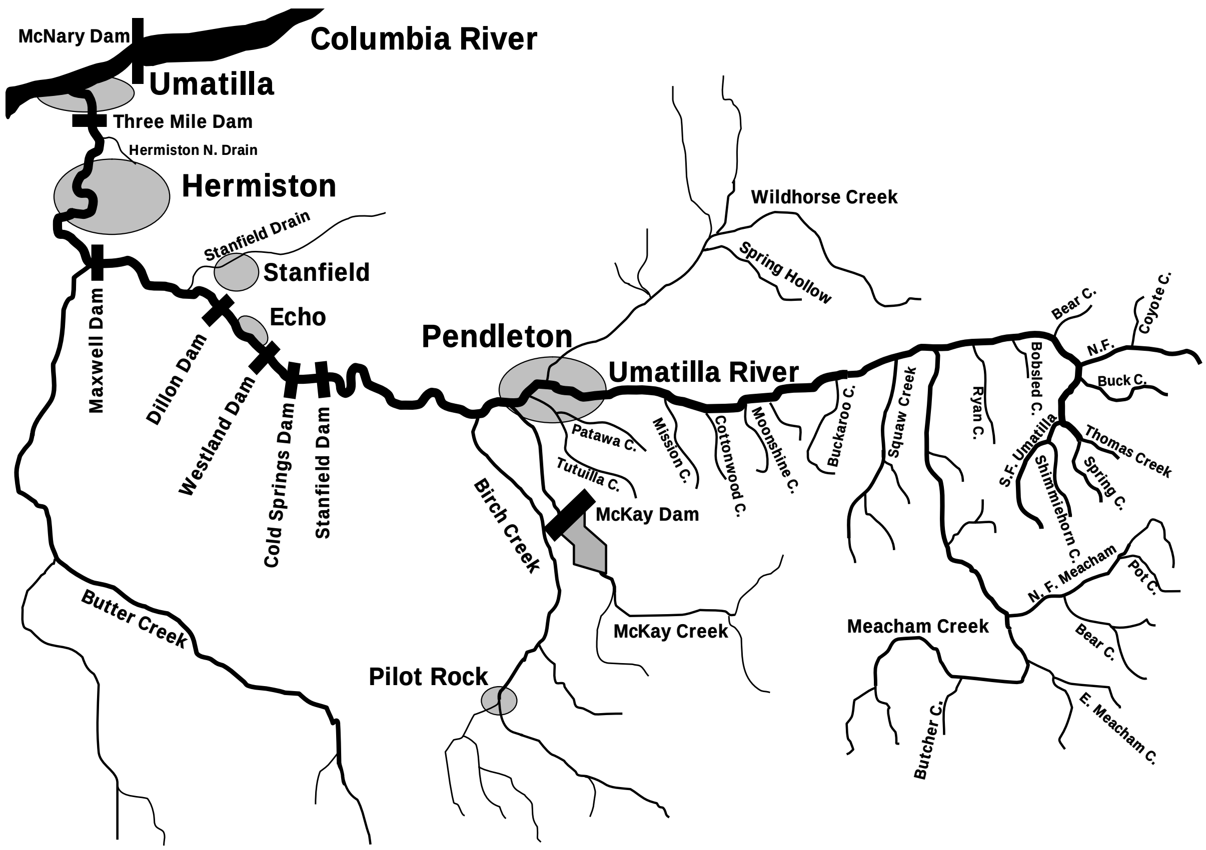


Figure 14. The Umatilla River and some of its tributaries.

Table 5. Umatilla River tributary lengths and drainage areas.

Drainage	Length (miles)	Area (sq. miles)	Distance from the mouth of the Umatilla River (miles)
North Fork Umatilla	9	34	89
South Fork Umatilla	10	57	89
Meacham Creek	31	165	79
Wildhorse Creek	34	190	55
Tutuilla	10	61	52
McKay Creek	32	191	51
Birch Creek	31	291	47
Butter Creek	57	465	14

The headwaters of Willow Creek and Juniper Canyon Creek are also found in the Blue Mountains. Willow Creek originates near Bald Mountain at over 5,500 feet. It is 79 miles long and drains an area of 880 square miles. The primary tributaries of Willow Creek are Eightmile Creek and Rhea Creek (Figure 2). The headwaters of Juniper Canyon Creek begin at nearly 2000 feet. The mainstem is 19 miles long and drains 72 square miles. The primary tributaries of Juniper Canyon Creek are the North and South Forks of Juniper Canyon.

Flows in the Umatilla/Willow subbasin are characterized by high peaks during the early spring and often extremely low flows in the summer. This hydrologic pattern is exhibited in the Umatilla River mainstem (Figure 15), its tributaries (Figures 16 and 17), and in Willow Creek (Figure 18). Hydrologic data for Juniper Canyon is limited; however, this watershed is characterized by intermittent flows with spring peaks.

The patterns in flow observed in the Umatilla/Willow subbasin are the result of snow melt and rain in late winter and early spring which cause peaks in flow. Water runoff peaks in April, while the lowest flows, or baseflows, generally occur in September. The average monthly discharge of the Umatilla River near its mouth (measured at RM 2.1) varies from 23 cubic feet per second (cfs) in July to 1095 cfs in April (low flow at the mouth occurs in July rather than September because of upstream removals for irrigation) (Figure 15). This difference in monthly discharge largely reflects seasonal variation in precipitation and snow melt. Summer baseflows can be extremely low and many of the larger tributaries lose all surface flow during the summer through parts of their lengths. Flows in sections of Birch, McKay, Butter, and Meacham Creeks are subsurface during low flow periods (ODEQ 1998).

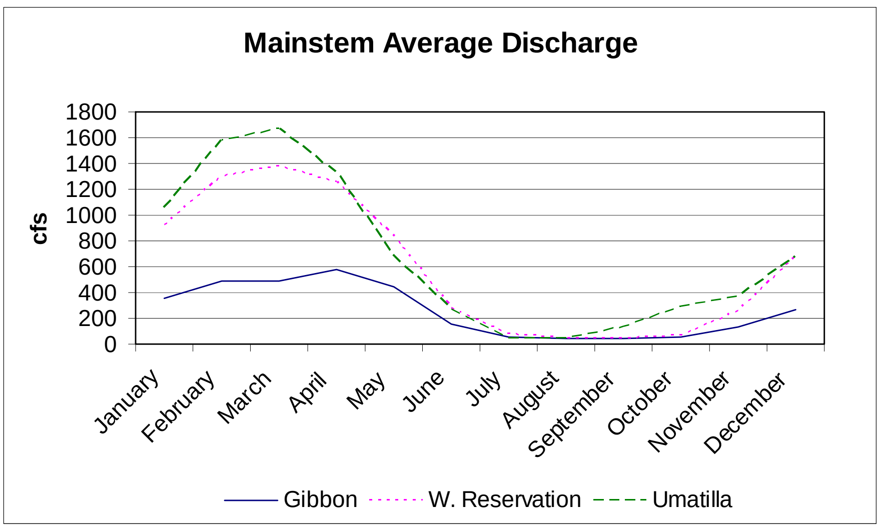


Figure 15. Monthly discharge of the Umatilla River at three gauging stations averaged over 5 years (1996-2000) (USGS 2004). The Gibbon station is at RM 83.1, the West Reservation station is at RM 58.3, and the Umatilla station is at RM 2.1.

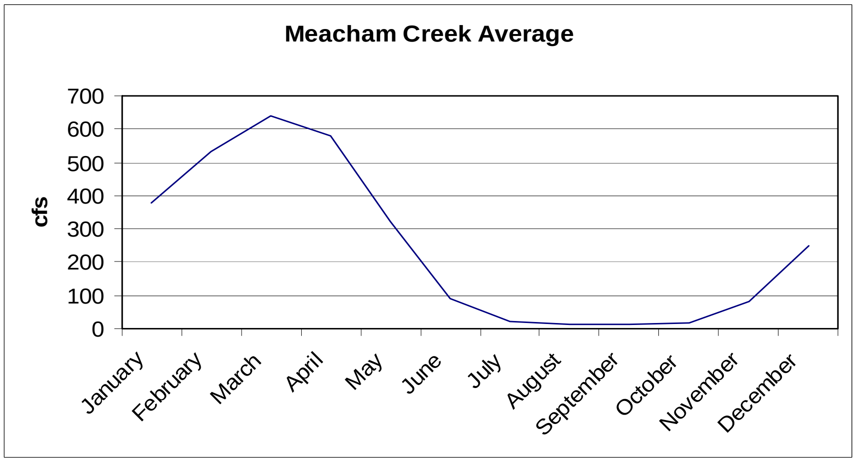


Figure 16. Monthly discharge at Meacham Creek averaged over 5 years (1996-2000) (USGS 2004). The gauging station is at RM 1.4, near Gibbon, Oregon.

The episodic hydrographs are exacerbated in the upper elevations of the Umatilla subbasin by steep-sided canyons, relatively impervious basalt bedrock, and diminished vegetation, which contribute to rapid runoff and poor groundwater recharge (CTUIR 1996). In contrast, in the lower subbasin, little runoff from uplands occurs due to the area's low precipitation, flat surface relief, and sandy soils (BOR 1954).

Peak flows in Willow Creek near Arlington occur in January, while further upstream, near Heppner, they occur between March and April (Figure l8). Peak annual discharges for Willow Creek, near Arlington, average 4,575 cfs. Base flows typically occur during the months of July – September, during which time channels may run intermittently or dry completely for prolonged periods, particularly in the lower reaches (OWRD 1988). However, isolated storm events may cause locally high flows for short periods during the summer and early fall (OWRD 1988).

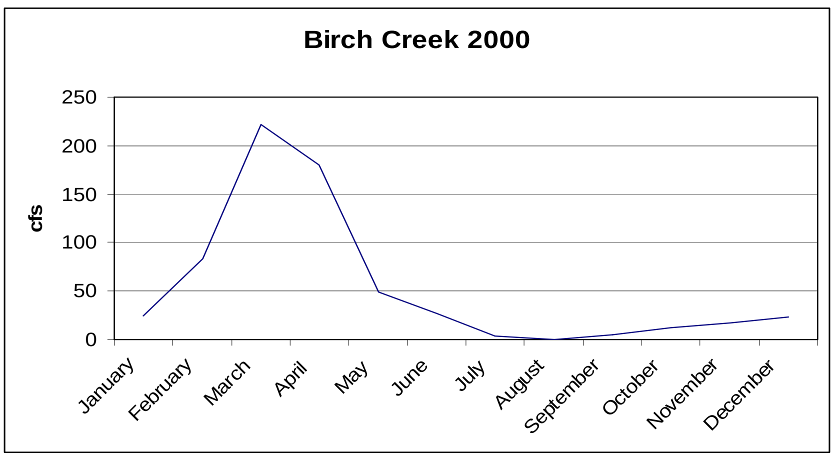


Figure 17. Monthly discharge at Birch Creek for the year 2000 (USGS 2004). The gauging station is located near the creek's mouth.

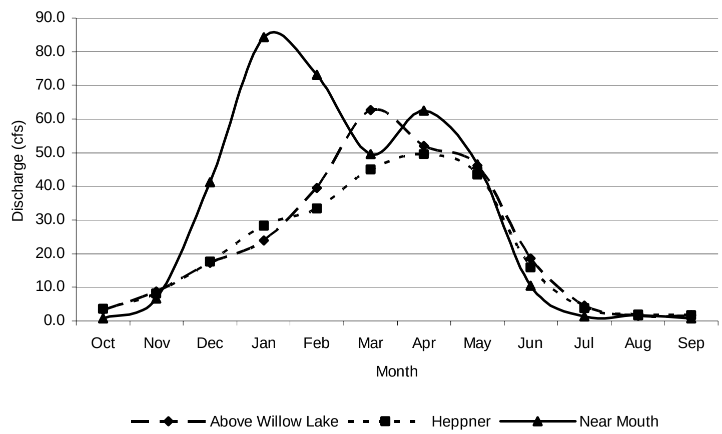


Figure 18. Mean monthly flows for Willow Creek at three gauging stations: above Willow Lake, in Heppner, and near Arlington.

Besides annual patterns in flow, gauge data can be used to determine bankfull discharge. Bankfull discharge is the discharge at which channel maintenance is the most effective (i.e., the discharge which is most effective at moving sediment, forming or removing bars, forming or changing bends and meanders, and generally doing work that results in the average morphologic characteristics of channels) (Dunne and Leopold 1978). In most systems, bankfull discharge is exceeded approximately once every year and a half (Dunne and Leopold 1978). Work in the Umatilla subbasin suggests that bankfull discharge is exceeded approximately once every 1.2 years (CTUIR 1999). Bankfull discharge is shown for six locations along the mainstem of the Umatilla River in Table 6.

Table 6. Bankfull discharge (peak flow with a 1.2 year recurrence interval) for six locations along the Umatilla mainstem (ODEQ et al. 2001).

River Mile	Station	Bankfull discharge (cfs)
80.1	Gibbon	1300
59.5	West Reservation	3000
55.0	Pendleton	3100
37.0	Yoakum Bridge	3700
26.0	Echo	3700
2.1	City of Umatilla	3075

Another significant component of the subbasin's hydrology that is often overlooked is the exchange of ground and surface water in rivers. This exchange is commonly viewed as a unidirectional process where ground water seeps into the river through the streambed. Thus, groundwater dynamics are commonly underestimated as a potential influence on river temperature. In alluvial rivers such as the Umatilla River, ground- and surface-waters circulate continuously and bidirectionally between the river channel and alluvial aquifer, which underlies the river and flood plain. This bidirectional exchange creates a shallow ground-water flow network known as the hyporheic zone. Because hyporheic flow circulates continuously, the potential for ground-water to influence stream temperature may be much higher in streams and rivers with substantial hyporheic flow.

Hyporheic flow is driven by hydraulic gradients within the alluvial aquifer; underground, water flows only when hydraulic gradients are present and ground water always moves along these gradients. In alluvial aquifers, hydraulic gradients are created by interactions between channel geomorphology and river hydrology. The presence of geomorphic features such as pool-riffle sequences, meander bends, backwaters, and side channels all create hydraulic gradients and therefore facilitate hyporheic flow.

If the geomorphic structure of a river influences hyporheic water exchange and if hyporheic dynamics may influence stream temperature, it follows that the geomorphic complexity of a river channel (as indicated by the frequency of pool-riffle sequences, meander bends, etc.) may play an important role in regulating river temperature. This relatively novel idea has been the focus of a three year research effort to test the hypothesis that the geomorphic structure of the Umatilla River controls the patterns of hyporheic flow within the river and therefore influences the river's temperature.

Based on this hypothesis, the research focused on five distinct efforts: 1) testing the utility of various types of remote sensing and other spatial data sets to document flood plain geomorphology and patterns of river temperature at multiple spatial scales; 2) from the most useful data sets, developing techniques to assess the geomorphic structure of the river channel and flood plain at multiple spatial scales; 3) developing modeling techniques to simulate ground- and surface-water dynamics in the river channel and alluvial aquifer; 4) comparing model results to remotely sensed patterns of stream temperature to test the hypothesis that that hyporheic flow is influencing water temperature in the river; and 5) determining if channel engineering (dredging and diking along the river) has resulted in simplified river and flood plain morphology, reduced hyporheic flow, and increased river temperatures. Two major conclusions from this research are:

1) Like many rivers, the Umatilla becomes warmer as water flows from the headwaters downstream. However, areas where hydrologic modeling predicts high rates of hyporheic flux tend to be the same areas where the downstream warming trend is reduced or even reversed. Thus, high rates of hyporheic exchange are associated with cooler stream temperatures.
2) Channel engineering results in substantially simplified channel and flood-plain morphology. Where major channel engineering projects have occurred, modeled rates of hyporheic exchange are noticeably reduced from similar areas where dredging and diking have not occurred. Therefore, reduced hyporheic exchange associated with channel engineering provides a likely mechanism to explain the tendency for the river to warm rapidly as it flows through engineered reaches.

This research has resulted in substantial new understanding of the interactions between geomorphology, hydrology, and river temperature in parts of the Umatilla River. Further, these research results suggest that geomorphic restoration of floodplains could play a vital role in the management of river temperatures and pilot projects that are carefully and cautiously planned, executed, and monitored should be implemented to test their effectiveness.

3.1.2.2 Water Quality

A Total Maximum Daily Load (TMDL) and Water Quality Management Plan (WQMP) were completed for the Umatilla subbasin in 2001 (ODEQ et al. 2001). A TMDL is currently being developed for the Willow Creek subbasin and a WQMP was recently completed (Willow Creek Local Advisory Committee et al. 2003). In addition, the Umatilla Tribes have requested to be treated as a state (pursuant to the Water Quality Act of 1987, an amendment to the Clean Water Act of 1972) and have coordinated with the Environmental Protection Agency (EPA) to develop water quality standards pertaining specifically to reservation lands (CTUIR 1999).

Beneficial uses of the Umatilla subbasin waters are varied. Water quality standards are determined to support beneficial uses designated in the Oregon Administrative Rules (Table 7). For the Willow Creek subbasin, a component of the developing draft assessment of the Willow Creek TMDL identifies salmonid spawning and water contact recreation as beneficial uses of the Willow Creek subbasin waters (ODEQ 2001, based on communication with ODFW in 2000).

Table 7. Designated beneficial uses of water in the Umatilla subbasin (from OAR 340-41, Table 11).

Public Domestic Water Supply	Anadromous Fish Passage
Private Domestic Water Supply	Salmonid Fish Rearing
Industrial Water Supply	Salmonid Fish Spawning
Irrigation	Resident Fish and Aquatic Life
Livestock Watering	Wildlife and Hunting
Boating	Fishing
Aesthetic Quality	Water Contact Recreation
	Hydropower

Of these beneficial uses, domestic water supply, salmonid life cycles, and water contact recreation are not fully supported as a result of water quality impairments found throughout the Umatilla/Willow subbasin. Water quality impairments arise from a variety of variables and have resulted in many reaches in the Umatilla/Willow subbasin listed in accord with Section 303(d) of the Clean Water Act of 1972 as being water quality-limited water bodies.

Water quality standards are established to protect beneficial uses of public waters. The most sensitive use is selected and the water quality standard is developed for this use, thus protecting it and all others (Figure 19). Parameter-specific, numeric water quality standards are described in more detail in Table 8. However, two parameters, habitat modification and sedimentation, currently lack numeric standards.

Table 8 describes the standards targeted by the Umatilla subbasin 2001 TMDL effort. In March of 2004, the EPA approved new water quality standards for temperature and dissolved oxygen (ODEQ 2004). Because the temperature TMDL is consistent with the updated standard, no substantive change to the TMDL is expected (personal communication: D. Butcher, ODEQ, March 2004).

The 1998 303(d) listed river and tributary segments were addressed by the 2001 TMDL. TMDL issuance delists the impairments, which are still tracked as water quality limited until TMDL attainment and water quality data indicate no further impairment. The listed reaches that triggered TMDL development are shown in Table 9. In 2002, a new 303(d) listing was developed; these reaches are shown in Table 10.

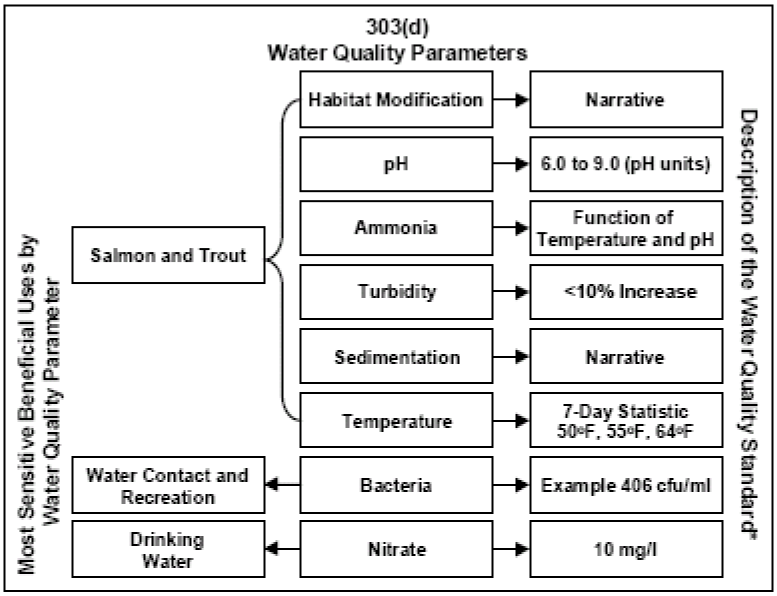


Figure 19. Linkages between beneficial uses and water quality standards (ODEQ et al. 2001).

A brief summary of the major variables resulting in 303(d) listings for the Umatilla/Willow subbasin is presented below. Additional information on these variables can be found in the Umatilla River Basin TMDL report (ODEQ et al. 2001).

Ammonia: Most reaches in the subbasin have low levels of ammonia (less than 0.1 mg/L). Exceptions include the lower Umatilla River and the North Hermiston Drain, which are in violation of EPA ammonia standards, primarily because of excessive temperatures and pH during the summer months (ODEQ et al. 2001). Other problem areas include Butter Creek, where ammonia concentrations have been measured at 0.3 to greater than 0.4mg/L (ODEQ 1998).

Aquatic Weeds/Algae and pH: Excessive growth of attached algae (periphyton) and attendant increases in pH are common during summer months throughout much of the mainstem Umatilla River (from Speare Canyon, RM 44, to the forks) (ODEQ et al. 2001). Large periphyton mats can be found in this section of the Umatilla River in the summer, affecting river odor, aesthetics, contact recreation, and pH. As periphyton obtains carbon dioxide for cell growth it decreases bicarbonate levels in the water. This has the effect of increasing pH levels, which can be stressful to fish. Because periphyton growth is positively influenced by water temperature, patterns in summer water pH are influenced by water temperature. pH increases from the forks to RM 58 (Figure 20), where it frequently exceeds 9.0 (the water quality standard); pH drops at RM 49 because of inputs of cold water from McKay Reservoir and then increases downstream where it

Table 8. Umatilla subbasin water quality standards (from ODEQ et al. 2001, except where noted).

Parameter	Standard
Ammonia	Standards are pH dependent. Chronic standards range from 0.08 mg/L-N at a pH of 8.5-9.0 to 0.85 mg/L-N at a pH of 6.5-7.0. Acute standards range from 0.59 mg/L-N at a pH of 8.5-9.0 to 13.48 mg/L-N at a pH of 6.5-7.0.
Aquatic Weed/Algae	OAR 340-41-645(2)(h): The development of fungi or other growths having a deleterious effect on stream bottoms, fish or other aquatic life, or which are injurious to health recreation, or industry, shall not be allowed.
Bacteria	A 30-day log mean of 126 *E. coli* organisms per 100 ml based on a minimum of five samples; or no single sample shall exceed 406 *E. coli* organisms per 100 ml.
Dissolved Oxygen (DO) *	For water bodies providing salmonid spawning during periods from spawning until fry emergence from the gravels, the following criteria apply: DO shall not be less than 11.0 mg/L, but if the minimum intergravel DO measured as a spatial median is 8.0 mg/L or greater, then the DO criterion is 9.0 mg/L. Where conditions of barometric pressure, altitude, and temperature preclude attainment of the 11.0 mg/L or 9.0 mg/L criteria, DO levels shall not be less than 95% of saturation. For water bodies identified by Oregon Department of Environmental Quality (ODEQ) as providing cold-water aquatic life, the DO shall not be less than 8.0 mg/L as an absolute minimum. The DO level for cool-water aquatic life shall not be less than 6.5 mg/L. The minimum DO level for warm-water aquatic life is 5.5 mg/L.
Iron	Not to exceed 1.0 mg/L (EPA 1986)
pH (Hydrogen Ion Concentration)	pH shall not fall outside the range of 6.5 to 9.0. The ODEQ will determine if any pH values higher than 8.7 are anthropogenic or natural in origin. Where it is proven that any waters impounded by dams existing on January 1, 1996 would not have a pH exceedance if the impoundment was removed, exceptions will be made.
Manganese	Not to exceed 0.10 mg/L (EPA 1986)
Nitrate	Not to exceed 10 mg/L
Temperature *	The basic absolute criterion is ≤ 64°F (17.8°C). Two exceptions exist: when salmonid spawning, egg incubation, and fry emergence for native fish occur, standards for the specific times of use are ≤ 55°F (12.8°C); and when the waters support bull trout the standards are ≤ 50°F (10.0°C) (Boyd et al. 1999).
Turbidity (Nepholometric Turbidity Units, NTU)	The water quality standards are: No more than a 10% cumulative increase in natural stream turbidities shall be allowed, as measured relative to a control point immediately upstream of the turbidity causing activity. A specific turbidity target of 30 NTU not to exceed 48 hours was developed for the Umatilla basin TMDL.

* New EPA standards were developed for these parameters in 2004 (ODEQ 2004).

Table 9. Impaired stream reaches from the 1998 303(d) list and used for development of the 2001 Umatilla subbasin TMDL (ODEQ et al. 2001).

Parameter	Stream	Segment (boundaries)	Criterion
Temperature	Birch Creek	Mouth to headwaters	Rearing 64°F
	Buckaroo Creek	Mouth to headwaters	
	E. Birch Creek	Mouth to Pearson Creek	
	EF Meacham Creek	Mouth to headwaters	
	McKay Creek	Mouth to McKay Reservoir	
	Meacham Creek	Mouth to headwaters	
	NF McKay Creek	Mouth to headwaters	
	NF Meacham Creek	Mouth to headwaters	Oregon Bull Trout
	NF Umatilla River	Mouth to headwaters	
	Shimmiehorn Creek	Mouth to headwaters	
	SF Umatilla River	Mouth to headwaters	
	Squaw Creek	Mouth to headwaters	Rearing 64°F
	Umatilla R.	Mouth to Lick Creek	
	W. Birch Creek	Mouth to headwaters	
	Westgate Canyon	Mouth to headwaters	
	Wildhorse Creek	Mouth to headwaters	
Sediment	Beaver Creek	Mouth to headwaters	See Narrative
	Birch Creek, WF	Mouth to headwaters	
	Boston Canyon Creek	Mouth to headwaters	
	Coonskin Creek	Mouth to headwaters	
	Cottonwood Creek	Mouth to headwaters	
	Line Creek	Mouth to headwaters	
	Little Beaver Creek	Mouth to headwaters	
	Lost Pin Creek	Mouth to headwaters	
	McKay Creek, NF	Mouth to headwaters	
	Meacham Creek	East Meacham Creek to	
	Mill Creek	Mouth to headwaters	
	Mission Creek	Mouth to headwaters	
	Moonshine Creek	Mouth to headwaters	
	Rail Creek	Mouth to headwaters	
	Sheep Creek	Mouth to headwaters	
	Twomile Creek	Mouth to headwaters	
	Umatilla River	Wildhorse Creek to Forks	
Turbidity	Umatilla River	Mouth to Mission Creek	>30 NTU
pH	Umatilla River	Speare Canyon to Forks	pH 6.5-9.0
Nitrate	Wildhorse Creek	Mouth to headwaters	>10mg/L
	Spring Hollow Creek	Mouth to headwaters	
Ammonia	Umatilla River	Mouth to RM 5	pH dependent: see Table 8
	North Hermiston Drain	Mouth to headwaters	
Bacteria	McKay Creek	Mouth to McKay Reservoir	Water Contact Recreation (fecal coliform 96-Std)
	Umatilla River -- Summer	Mouth to Speare Canyon	
Aquatic Weeds/Algae	Umatilla River	Speare Canyon to Forks	Growth considered to be deleterious to aquatic life, public health, recreation or industry

Table 9 (continued). Impaired stream reaches from the 1998 303(d) list and used for development of the 2001 Umatilla subbasin TMDL (ODEQ et al. 2001).

Parameter	Stream	Segment (boundaries)	Criterion
Flow Modification	Birch Creek	Mouth to Headwaters	
	Umatilla River	Mouth to Speare Canyon	
Habitat Modification	Bell Cow Creek	Mouth to Headwaters	ODFW Habitat Benchmarks
	Boston Canyon Creek	Mouth to Headwaters	
	Calamity Creek	Mouth to Headwaters	
	Coonskin Creek	Mouth to Headwaters	
	Cottonwood Creek	Mouth to Headwaters	
	Darr Creek	Mouth to Headwaters	
	E. Birch Creek	Mouth to Headwaters	
	Line Creek	Mouth to Headwaters	
	Little Beaver Creek	Mouth to Headwaters	
	Lost Pin Creek	Mouth to Headwaters	
	Meacham Creek	Mouth to Headwaters	
	Mill Creek	Mouth to Headwaters	
	Mission Creek	Mouth to Headwaters	
	Moonshine Creek	Mouth to Headwaters	
	N.F. McKay Creek	Mouth to Headwaters	
	N.F. Meacham Creek	Mouth to Headwaters	
	Rail Creek	Mouth to Headwaters	
	Umatilla River	Wildhorse Creek to Forks	
	Wood Hollow Creek	Mouth to Headwaters	

Table 10. 2002 303(d) listed stream reaches in the Umatilla/Willow subbasin (ODEQ 2003).

Variable	Stream	Segment (boundaries)	Criterion
Temperature	Willow Creek	Mouth to Headwaters	Rearing 17.8 °C
pH	Hermiston Ditch -- Summer	Mouth to RM 2.7	pH 6.5-8.5
	Willow Creek	Mouth to RM 51.7	
Nitrate	Unnamed Waterbody	Mouth to RM 3.1	>10mg/L
Fecal Coliform	Balm Fork	Mouth to RM 9.5	Geometric mean of 200, No more than 10%>400
Dissolved Oxygen	Umatilla River – Fall through Spring	Mouth to RM 32.1	<95% saturation
Manganese	Umatilla River	Mouth to RM 32.1	>0.10 mg/L
Iron	Birch Creek	Mouth to RM 15.6	>1.0 mg/L
	Butter Creek	Mouth to RM 18	
	McKay Creek	Mouth to RM 15	
	Umatilla River	Mouth to RM 56	
	Wildhorse Creek	Mouth to RM 33.1	

routinely exceeds the water quality standard at Yoakum Bridge (RM 37.2) (Figure 20) (ODEQ et al. 2001). Elevated summertime temperatures and excessive algal growth are also likely contributors to high pH levels recorded in Willow Creek, from the mouth upstream to Heppner.

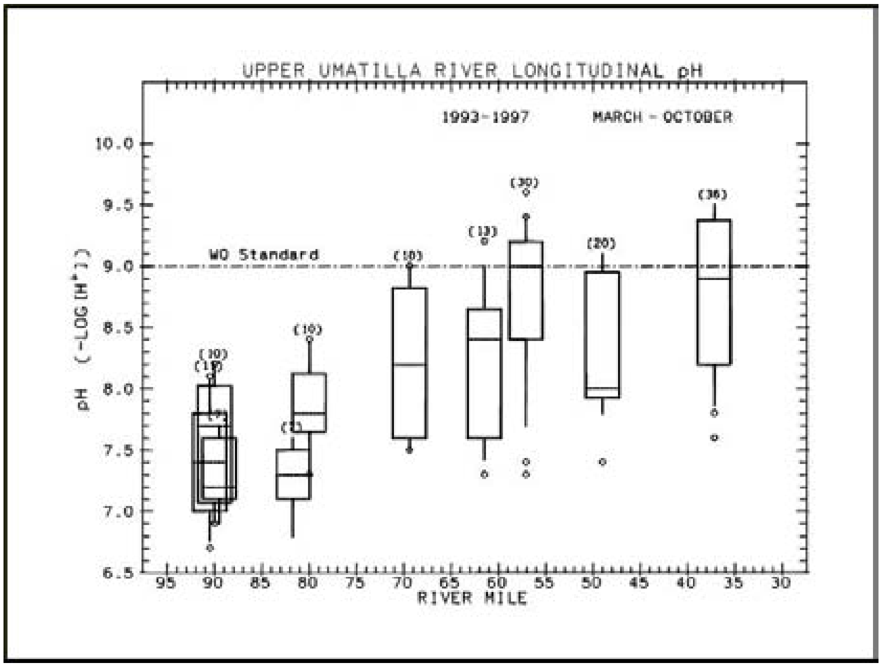


Figure 20. pH of the upper Umatilla River (ODEQ et al. 2001).

Bacteria: The 1998 303(d) listings (Tables 9 and 10) were based on fecal coliform samples exceeding the standard (400 colonies/100ml) in the listed reaches. Fecal coliform bacteria are found in the fecal matter of warm-blooded animals, including humans. In 1996 the State of Oregon revised its bacteria standards to be based on *Escherichia coli* instead of fecal coliform. *E. coli* is the most common type of fecal coliform bacteria and is rarely harmful; however, its presence in water indicates sewage or other fecal contamination, both of which may contain disease-causing organisms (ODEQ et al. 2001). Most reaches and tributaries of the Umatilla River upstream of Pendleton have low levels of *E. coli* bacteria (less than 150 per 100 ml). Areas in the subbasin with high *E. coli* counts include the middle reaches of Wildhorse Creek (450 to 600 per 100 ml), the Umatilla River near and downstream of the city of Pendleton (greater than 600 per 100ml), and the lower and middle reaches of Butter Creek (greater than 600 per 100 ml) (ODEQ 1998). Bacteria levels are also high in the Balm Fork of Willow Creek.

Flow Modification: The Umatilla mainstem has been listed for flow modification from Speare Canyon to the mouth and one of the Umatilla's tributaries, Birch Creek, has also been listed from its headwaters to mouth. The magnitude and cause of flow modification in the Umatilla/Willow subbasin is reviewed in Sections 3.1.1.9 and 3.1.3.2.

Habitat Modification: The mainstem Umatilla River from Wildhorse Creek to the forks and sections of 17 tributaries of the mainstem are 303(d) listed because of habitat (including substrate) problems (see Table 9). Habitat benchmarks developed by ODFW (Oregon Department of Fisheries and Wildlife) were used to 303(d) list stream reaches based upon standardized habitat surveys (Moore et al. 1999). Parameters measured in these surveys include habitat features known to be important to salmonids such as presence and amount of large woody debris, pool frequency, presence of eroding streambanks, type of riparian vegetation, stream channel form and pattern, and the proportion of the substrate composed of fine materials.

Nitrate: The two stations (Spring Hollow Creek, a tributary to Wildhorse Creek, and Wildhorse Creek) for which nitrate standards are in violation have concentrations that violate general criteria set for public water supplies (<10 mg/L). Concentrations at these stations may represent a serious health concern for infants and pregnant or nursing women (Oregon Health Division, Environmental Toxicology Section 1990 cited in ODEQ et al. 2001).

Sediment and Turbidity: The Umatilla River produces large amounts of sediment, much of which originates from weathered basalt and unconsolidated loess deposits -- the dominant geology in the subbasin. The primary sources include both bank and upland erosion of tributaries and tributary watersheds, both of which may be accelerated by land uses (ODEQ et al. 2001). The dominant erosion processes in the subbasin are surface erosion by sheetwash, rills and gullies, and bank erosion (ODEQ et al. 2001). Peak sedimentation usually occurs during rainstorms or snowmelts associated with freeze and thaw periods (CTUIR and ODFW 1990). The entire Umatilla mainstem from the mouth to the forks is listed for either sediment or turbidity.

Neither EPA nor the State of Oregon has established numeric water quality standards for suspended solids or streambed fines. Umatilla Basin fisheries managers, however, determined through basin-specific knowledge and literature review that an instream turbidity standard of 30 nephelometric turbidity units (NTU's), that does not exceed a 48-hour duration, will protect aquatic species (ODEQ et al. 2001). The 30 NTU target was correlated to total suspended solids (TSS) data to derive watershed target concentrations/loading capacities. The 303(d) listings were based on stream surveys, using ODFW Habitat Benchmarks for silt, sand, and organics, in upper watershed areas. The TMDL uses turbidity as the target for reducing the amount of suspended material available for settling.

One of the sediment-impaired stream segments that significantly deviated from the target standard for turbidity was Wildhorse Creek (at its confluence with the Umatilla River), which had a peak turbidity value of over 5,000 NTU measured on April 23, 1997. High levels were also measured in McKay Creek. Wildhorse Creek turbidity mainly results from spring runoff, while McKay's turbidity is mostly a result of bottom withdrawal of water from the reservoir for flow augmentation. Composite samples of turbidity, collected at various stations during the winter of 1997-1998, show that Tutuilla, Birch, and five sites on the Umatilla mainstem exceeded standards on numerous occasions (ODEQ et al. 2001).

Suspended sediment is often deposited on streambeds where it forms an unstable part of the substrate. High levels of substrate sediment often fill the interstitial spaces between gravel and cobble, which can negatively influence the survival of salmon eggs and alevins (Cooper 1965, Mundie and Crabtree 1997). Surveys conducted by ODFW and CTUIR throughout the Umatilla River subbasin found that 19 of 42 stream reaches had fine sediment as the dominant substrate (Boyd et al. 1999). In the Patawa/Tutuilla watershed, fine sediment made up the dominant substrate in 9 of 19 reaches surveyed (Watershed Professionals and Duck Creek Associates 2003). Substrate sediment is less of a problem in the upper Umatilla subbasin; a survey of the upper Umatilla River and Meacham Creek by the Umatilla National Forest (2001) in which substrate embeddedness was measured directly found that only two sub-watersheds of 18 had embeddedness levels greater than 35% (a level of embeddedness considered detrimental to salmon).

Temperature: Water temperature is a concern throughout most of the Umatilla/Willow subbasin during periods of low flow (May until early November). On the 1998 303(d) list, 287 miles of the Umatilla River and its tributaries were listed as impaired for elevated water temperatures including the entire mainstem Umatilla River (ODEQ et al. 2001) (Figure 21). The highest water temperatures have been recorded in late July and early August when ambient air temperatures are high. During this period, the Umatilla River warms rapidly from the headwaters to the mouth, reaching sub-lethal (64-74°F, 20-23°C) and incipient lethal temperatures (70-77°F, 21-25°C) for its entire length (Boyd et al. 1999; Contor and Crump 2003) (Figures 22 and 23). Many of the tributaries also reach sub-lethal and incipient lethal ranges for salmonids (Boyd et al. 1999; CTUIR 2004a).

The Umatilla subbasin’s coolest mid-summer recorded temperatures are in the North Fork of the Umatilla River, where maximum summer temperatures usually do not exceed the state standard of 64°F (17.8°C). For example, in the summer of 2002, maximum water temperature in the North Fork did not exceed 60.8°F (16.0°C) (Contor and Crump 2003). The South Fork of the Umatilla River experiences higher summertime temperatures often above 64°F, though rarely above 70°F. Data indicate a significant increase (approximately 5° F) in temperature from the Umatilla River east of the Gibbon site (RM 80.0) to the Umatilla River at Cayuse Bridge (RM 69.4). This increase in temperature is attributed to Meacham Creek which enters the Umatilla Mainstem at RM 79. Summer water temperatures in Meacham Creek are frequently in the high 60s ºF. However, maximum summer temperatures drop further downstream (at RM 50; Figures 22 and 23) as a result of cold water releases from McKay Reservoir for the benefit of irrigation and fish.

One of the warmest tributaries of the Umatilla River is Wildhorse Creek. This drainage regularly experiences excessive summertime stream temperatures throughout the entire stream length. Headwaters often exceed 70˚F for long periods in the summer, while lower Wildhorse Creek can often experience stream temperatures exceeding 85˚F.

The temperature regime in Willow Creek is similar; the entire mainstem can exceed criteria for salmonid rearing (64°F, 17.8° C). In addition, water frequently reaches sublethal and incipient lethal temperatures from the mouth to RM 62 from June through

September (ODEQ et al. 2001). These high temperatures extend into Rhea Creek, one of Willow Creek's main tributaries.

Excessive stream temperatures in the Umatilla/Willow subbasin are influenced primarily by non-point sources including riparian vegetation disturbance (reduced stream surface shade), summertime diminution of flow (reduced assimilative capacities), and channel widening (increased surface area exposed to solar radiation) (ODEQ et al. 2001).

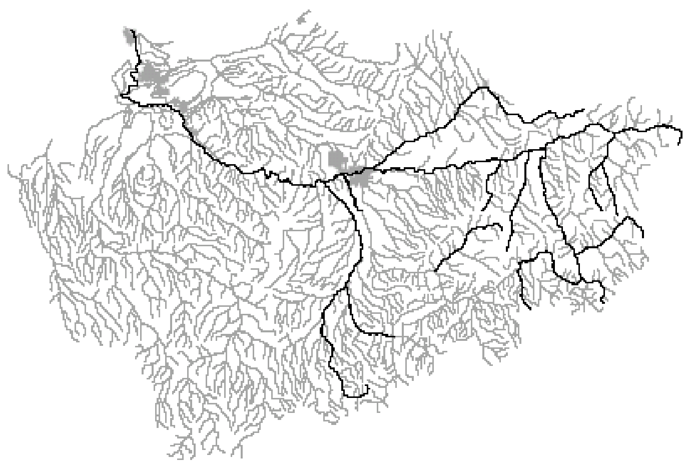


Figure 21. Stream segments listed for temperature on the 1998 303(d) list.

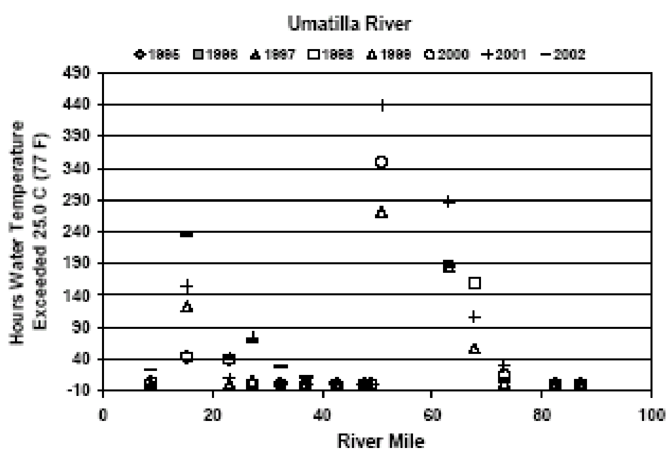


Figure 22. The number of hours water temperatures exceeded 25°C during June-September, 1995-2002, in the Umatilla River at selected sites from RM 8-87.

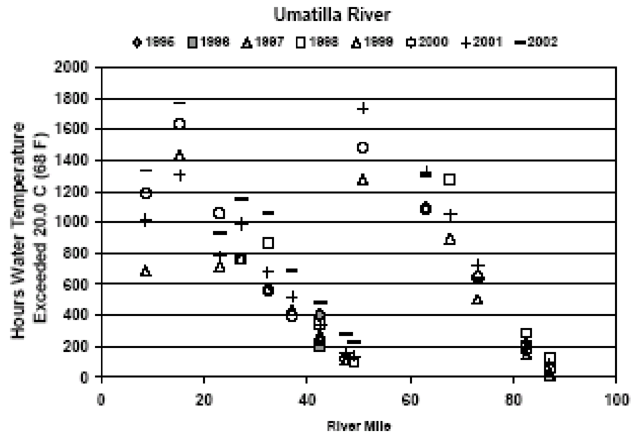


Figure 23. The number of hours water temperatures exceeded 20°C during June-September, 1995-2002, in the Umatilla River at selected sites from RM 8-87.

3.1.2.3 Riparian Resources

The current condition of the riparian vegetation varies considerably throughout the Umatilla/Willow subbasin. The majority of the riparian vegetation in the upper tributaries is composed of narrow bands of hardwood and conifer species. Much of these areas are on National Forest lands. Galleries of large mature cottonwoods exist in some areas of CTUIR land as well as in a few areas along the mainstem Umatilla River below Pendleton (RM 51). Lower mainstem and tributary reaches have riparian vegetation types primarily composed of shrubs and grasses, with some scattered hardwood trees (e.g., ash, cottonwood, and alder). In some cases where crop cultivation extends to the stream banks or where grazing pressure is high, woody or shade-producing riparian vegetation is sparse. Much of the lower mainstem is diked, and trees are actively prevented from growing on the dikes.

Riparian vegetation on the mainstem Umatilla River and many tributaries is in poor condition, with approximately 70% of 422 miles inventoried identified as needing riparian improvements (CTUIR and ODFW 1990). Losses of riparian vegetation are particularly high in the lower subbasin; Kagan et al. (2000) estimated these losses at greater than 95% as compared to pre-settlement conditions (c. 1850).

3.1.2.4 Wetland Resources

An assessment of wetlands along the Umatilla River corridor was conducted by the CTUIR and developed into a Wetland Protection Plan (CTUIR 1997). The assessment was conducted using National Wetlands Inventory maps and found that 10,090 acres of wetlands occur along the mainstem corridor. That acreage can be divided into three different types of wetlands: 4,400 acres of lacustrine wetlands (those associated with ponds and reservoirs), 4,250 acres of palustrine wetlands (those typically referred to as "swamps", "bogs" or "marshes"), and 1,440 acres of riverine wetlands (riparian areas adjacent to streams and rivers). Based on a limited analysis conducted by the CTUIR (1997), wetland losses in the upper Umatilla River range from 30 to 35%, while wetland losses in the Umatilla/Echo Meadows area are estimated to be as high as 90%. The CTUIR (1997) analysis identified three important wetland areas: Minthorn Springs on the Umatilla Indian Reservation, a braided portion of the Umatilla River downstream of Pendleton, and the Echo/Umatilla Meadows complex.

The Minthorn Springs area (RM 65) represents a riverine and palustrine wetland complex formed by the interface of the springs and the Umatilla River. The area contains approximately 19 acres of palustrine wetlands and 11 acres of riverine wetlands. Historically, the wetland received water inputs from intermittent tributaries. Input from those streams has now been reduced because upland farming has either eliminated or rechanneled the stream channels. Additionally, cottonwood forest riparian areas that once existed along the upland channels have either been reduced or completely removed, resulting in intermittent streams drying up earlier in the year. This area is important for water quality and quantity, and fish and wildlife habitat (CTUIR 1997).

The second focus area is located in the mid- to lower river corridor west of Pendleton (RM 47). This area contains braided river channels and a cottonwood gallery with approximately eight acres of palustrine wetlands and five acres of riverine wetlands. This portion of the Umatilla River has been channelized for transportation routes (roads and railways), agricultural development, and diking. This area serves as a corridor for fish and wildlife and represents a habitat that was once much more common prior to human impacts (CTUIR 1997).

The Echo-Umatilla Meadows wetland complex is located lower in the Umatilla River corridor (between RM 18 and 24). This complex results from the broadening of the river's floodplain to nearly 10 times its upstream width. Examination of aerial photos reveals numerous side channels and oxbows that are now dry. These dry channels are generally within a mile of the existing high water mark. The area historically held palustrine wetlands that abated floods, trapped sediment, stored water, provided recharge to the river, and provided fish and wildlife habitat. The area currently contains an estimated 862 acres of palustrine wetlands and 152 acres of riverine wetlands. Primary impacts to this area include conversion to farmland, channelization for agriculture, roadways, railways, diking, and urbanization (CTUIR 1997).

3.1.3 Hydrological and Ecological Trends in the Subbasin

3.1.3.1 Trends in Climate and Their Effect on Hydrology and Ecology

The entire Umatilla/Willow subbasin falls within Oregon's North Central Climatic Zone (Zone 6), a relatively dry region with peak precipitation occurring in winter and dry summers (Oregon Climate Service 2004). Major influences on the climate are the Cascade Mountains and the Columbia Gorge to the west and the Blue Mountains to the east. The Cascade Mountains form a barrier to the passage of warm moisture-laden storm fronts from the Pacific Ocean into the Columbia basin interior. However, the Columbia Gorge provides a break in this barrier, occasionally allowing moisture laden air to penetrate to the Blue Mountains (Johnson and Clausnitzer 1992).

Mean annual temperature and precipitation records for a hundred year period for Zone 6 indicate that while temperature and precipitation have oscillated over this period, no obvious trends exist (Figures 24 and 25). More detailed information on climate is given in section 3.1.1.4.

Hydrology and ecology are influenced to a great degree by a region's climate. Thus, year-to-year variation in climate can result in year-to-year variability in the hydrologic regime and fish and wildlife populations. However, the lack of any obvious trends in climate through time (Figures 24 and 25) suggests that there should be little climate-induced trends in either hydrology or ecology in the subbasin.

The ecology of the subbasin is likely influenced by trends in climate outside of the subbasin. An important weather pattern in the Pacific Northwest that appears to have a strong influence on salmon survival in the ocean is the Pacific Decadal Oscillation (PDO) (Taylor and Southards 2003). The PDO pattern is of a period of cool, wet years followed by a period of warm, dry years. The impact of the PDO on the abundances of adult salmon and steelhead returning to the Columbia River and to the Umatilla/Willow subbasin is described in more detail in Section 3.3.1.

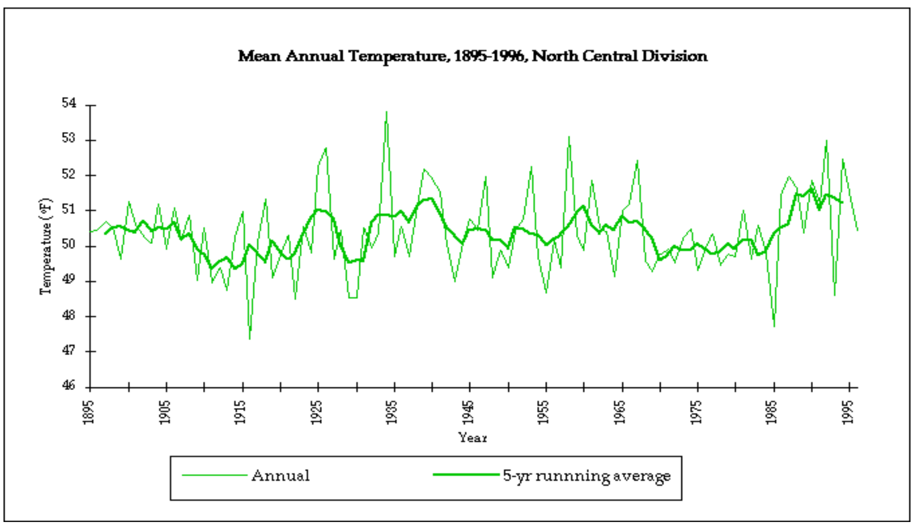


Figure 24. Air temperature in Climate Zone 6 (North Central) of Oregon (1895- 1995) (Oregon Climate Service 1999).

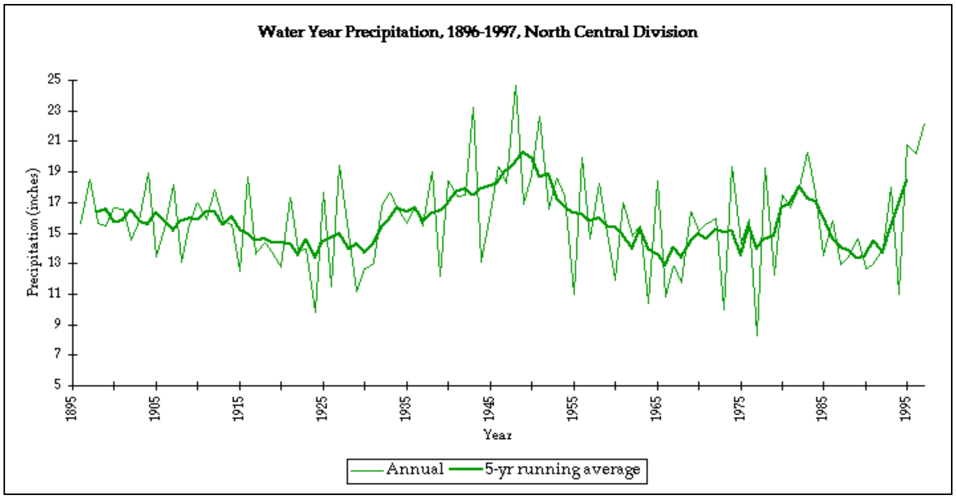


Figure 25. Precipitation in Climate Zone 6 (North Central) of Oregon (1895-1995) (Oregon Climate Service 1999).

Despite the lack of evidence of any obvious climate change in the Region 6 climatic zone, computer simulations of future weather generally agree that the climate is warming and will continue to warm during the next 50 years. TOAST (2004) provided this brief overview of probable impacts of climate change on the Pacific Northwest and the region's salmon:

> Computer models generally agree that the climate in the Pacific Northwest will become, over the next half century, gradually warmer and wetter, with an increase of precipitation in winter and warmer, drier summers (USDA Forest Service 2004). These trends mostly agree with observed changes over the past century. Wetter winters would likely mean more flooding of certain rivers, and landslides on steep coastal bluffs (Mote et al. 1999) with higher levels of wood and grass fuels and increased wildland fire risk compared to previous disturbance regimes (USDA Forest Service 2004). The region's warm, dry summers may see slight increases in rainfall, according to the models, but the gains in rainfall will be more than offset by losses due to increased evaporation. Loss of moderate-elevation snowpack in response to warmer winter temperatures would have enormous and mostly negative impacts on the region's water resources, forests, and salmon (Mote et al. 1999). Among these impacts are a diminished ability to store water in reservoirs for summer use, and spawning and rearing difficulties for salmon.

3.1.3.2 Trends in Anthropogenic Activities and Their Effect on Hydrology and Ecology

The current influence of human activities on aquatic and terrestrial environments is described in 3.1.1.9. The purpose of this section is to briefly describe trends in these activities through time and their corresponding impact on the hydrology and ecology of the Umatilla/Willow subbasin. Activities are presented in alphabetical order.

Agriculture[1]*:* When early settlers arrived in the Umatilla/Willow subbasin between 1843 and 1880, they found mountains covered with forests and plateau lands covered with native grasses. These settlers pursued an agrarian lifestyle, primarily raising livestock with limited crop production. Intensive tillage began during the 1880s, causing large amounts of native grassland to be converted to dry cropland. The completion of several irrigation and Bureau of Reclamation (BOR) projects shortly after the turn of the century (see discussion of water development below in this section) allowed for the conversion of arid areas in the lower basin into irrigated croplands. In the late 1940s and early 1950s, the need for large areas of pasture and hay production declined due to a reduction in the number of horses because of increased mechanization and government policy (e.g., WWII horse slaughter). Since the advent of modern irrigation systems, approximately 480,000 acres of land have been developed for crop production.

Other than water development (which is discussed below) agriculture has had two important impacts on the subbasin's fish and wildlife resources. First is the conversion of native grasslands and shrub-steppe plant communities to croplands. Historically (c. 1850), the Umatilla/Willow subbasin is estimated to have had 2,030,959 acres of grassland and 273,546 acres of shrub-steppe habitat (IBIS 2004). Currently, the subbasin has 528,269 acres of grassland (a reduction of 74%) and 628,795 acres of shrub-steppe (an increase of over 100%) (IBIS 2004). However, it is important to note that the overall increase in shrub-steppe habitat is primarily due to an increase in rabbit brush, as abandoned wheat fields have been enrolled in CRP, and does not reflect trends in specific types of shrub-steppe. For example, in the Umatilla/Willow subbasin, Kagan et al. (2000) estimates that big sagebrush steppe has declined by 86%, with historic coverage estimated at 302,704 acres and current coverage as 43,145 acres. Most of this habitat loss occurred in the northern part of the subbasin, on deeper loess soils, which are now farmed. Bitterbrush shrub-steppe, located primarily in the sandy areas of the northern part of the subbasin, has also experienced significant losses, with only 45% (43,540 acres in 1999) of the original habitat (94,171 acres c. 1850) remaining (Kagan et al. 2000). Bitterbrush shrub-steppe has declined primarily as a result of irrigated agriculture or industrial development. The largest remaining habitats of bitterbrush shrub-steppe are found on the Umatilla Army Depot and the Boeing Lease Lands, both of which face significant threats (Kagan et al. 2000). In addition, bluegrasss/rigid sage scabland has decreased by approximately 54%, from 268,356 acres c. 1850 to 124,022 acres in 1999 (Kagan et al. 2000).

The loss of high quality native shrub-steppe habitat can negatively affect terrestrial wildlife species. Kagan et al. (2000) examined seven birds species (Burrowing Owl, Sage Sparrow, Grasshopper Sparrow, Swainsons Hawk, Ferruginous Hawk, Long-billed Curlew, Loggerhead Shrike), two mammals (white-tailed jackrabbit, Washington ground-squirrel), two reptiles (sagebrush lizard and short-horned lizard), and one amphibian (Great-basin spadefoot), and found that sagebrush-steppe habitats are the most critical and limiting habitat for these species within the lower Umatilla/Willow subbasin (see

[1] The first paragraph of this section was adapted from information presented on pp. 3-4 of the Umatilla River Subbasin Agricultural Water Quality Management Area Plan (Umatilla River Subbasin Local Agricultural Water Quality Advisory Committee 1999)

Sections 3.2.4 and 3.5.2 for more discussion of selected focal species and their relationship to shrub-steppe habitat). Fragmentation of remaining shrub-steppe habitat can negatively affect terrestrial wildlife by altering dynamics of dispersal and immigration necessary for maintenance of some populations at a regional scale and by increasing certain interspecific interactions, such as parasitism (Altman 2000, Altman and Holmes 2000) (see Section 3.2.4.2 for more discussion of fragmentation of shrub-steppe habitats).

Agricultural impacts on wildlife have not all been negative, however. Agricultural areas support many small birds and mammals, important predators such as coyotes and red-tailed hawks, and game species such as ring-necked pheasants and wild turkey (Csuti et al. 1997; Edge 2001). The number of species inhabiting agricultural areas may be quite large; Edge (2001) estimates that the number of wildlife species supported by agriculture in eastern Oregon and Washington is similar to the number of species supported by eastside grasslands (about 170 species in each habitat type).

The second important impact of agriculture is erosion and sediment input into streams. Efforts to control erosion of topsoil were being made as early as the 1930s. Bennett (1947), discussing wheat production areas, stated that, "fair to good control of erosion can be obtained by plowing down stubble (rather than burning it) in such a way that part of the straw protrudes above the ground, affording considerable surface protection, especially against wind". Currently, sedimentation into streams continues to be a problem in the Umatilla/Willow subbasin with the mainstem and many tributaries 303(d) listed for sediment and turbidity (see section 3.1.2.2). The source of most sediment in streams in the subbasin is thought to be surface erosion (through sheetwash, rills and gullies) and streambank erosion (ODEQ et al. 2001). The relative contribution of each is unclear; however, recent work in the Wildhorse watershed, one of the largest sediment yielding tributaries of the Umatilla River, suggests that the majority of sediment in Wildhorse Creek comes from bank erosion and not from surface erosion as a result of cropping practices (Nagle and Ritchie 2004). Using carbon, nitrogen and Cesium-137 as tracers, Nagle and Ritchie (2004) estimate that bank material contributed from 74-88% of bottom sediments in Wildhorse Creek and surface soils contributed 12-26%. More work like this is needed throughout the subbasin to determine if this is a common pattern in sediment sources. This work suggests that, to control sediment in Wildhorse Creek, a premium should be placed on bank stabilization through riparian vegetation recovery with less effort directed towards changing cropping practices.

Recently, the impact of agriculture on fish and wildlife resources in the subbasin has been mitigated to a degree by conservation incentive programs. A variety of United States Department of Agriculture (USDA) incentive programs are currently available to crop growers through the local NRCS and county Farm Service Agency (FSA) offices. The most significant federal agriculture program in Umatilla County over the past 15 years has been the Conservation Reserve Program (CRP), which includes the Conservation Reserve Enhancement Program (CREP) and Continuous Conservation Reserve Program (CCRP). Under this program, growers get paid on an annual per acre basis to retire and set aside cropland areas. Contracts can be from ten to 15 years depending on specific practices involved. There are two types of sign-ups; a standard sign-up, which is on a bid basis, and during a designated sign-up period; the other option is a special practice sign-up, which can occur at any time. The special practice sign-up is for specific areas and often includes native grasses, trees, and shrubs. The CRP has achieved significant conservation and wildlife habitat benefits. As of 2003, Umatilla County had 108,000 acres in the program, with 347 acres enrolled in CREP, which involves installing riparian forest buffers along streams, and 991 acres enrolled in CCRP. Morrow County has 109,921.1 acres in the program, with 97.7 of those acres enrolled in CCRP. Table 11 summarizes the specific type of CRP practices conducted in Umatilla and Morrow counties from 1986-2001 (USDA 2000).

Other conservation-based programs include the Direct Seeding Program. The program is a partnership between the Umatilla County Soil and Water Conservation District (SWCD), Oregon State University (OSU) – Umatilla County Extension Service, EPA, ODEQ, and Oregon Watershed Enhancement Board (OWEB). The Direct Seeding Program provides growers with an incentive payment of $10 per acre for up to 200 acres per producer, and up to three crop rotations per entity. The program has increased the practice of direct seeding substantially. Before 1997, when the program began, growers rarely employed the practice; in 2003, growers used direct seeding on more than 50,000 acres in the subbasin, often without cost shares (personal communication: T. Straughan, ODA, March 2004).

Another USDA program which provides cost-share for installing conservation practices is the Environmental Quality Incentives Program (EQIP). EQIP funds are currently being used for supporting such practices as reduced tillage systems, direct seeding, nutrient management, cropland conversion to grasslands, and irrigation management. Contracts are for 1 to 10 years and provide up to 75% cost share. Resource concerns are prioritized for funding annually by a Local Working Group (personal communication: T. Straughan, ODA, April 2004).

Exotic Weed Introduction: Introduced exotic weeds are not a new problem in the Umatilla/Willow subbasin; early newspaper accounts from 1902 through 1923 describe wheat farmers in the Adams area of the Wildhorse Creek drainage having difficulties with “Russian thistle”, “tar weeds” and “Jim Hill Mustard” (Adams Ladies Club 1993, 1994). Since that time, both the number of exotic species established in the Umatilla/Willow subbasin and the acreage of lands invaded have increased, although the magnitude of these changes in the last 100 years has not been quantified. As discussed in Section 3.1.1.9, the spread of exotic weeds not only reduces the abundance and diversity of native vegetation, but can also negatively affect fish and terrestrial wildlife and natural ecological processes, such as fire regimes in shrub-steppe habitats.

Table 11. Acreages of specific CRP practices in the Umatilla/Willow subbasin from 1986-2001 (USDA 2000)

County	Conservation Reserve Practice	Activity Acres
Umatilla	established grass	47,536.4
	introduced grasses	32,597.3
	native grasses	14,076.1
	tree planting	853.5
	established trees	870.5
	wildlife habitat	9,971.9
	wildlife food plots	75.2
	grass waterways	44.9
	filter strips	1,071.3
	riparian buffers	185.5
Morrow	established grass	79,666.1
	introduced grasses	33,881.9
	native grasses	63.8
	field windbreaks	39.8
	wildlife food plots	17.5
	contour grasses	10.3
	filter strips	522.4
	riparian buffers	28.8

Forestry Practices: The USFS created the Umatilla National Forest in 1920 (USFS 2004). Shortly thereafter, commercial forestry began in the Umatilla subbasin. However, large amounts of timber were not cut until the 1950s. Data on harvest rates indicate that harvest peaked in the subbasin in the 1970s and declined substantially by the 1990s (Table 12).

However, some extensive logging has occurred in Morrow County recently (2003) on private property in the headwaters of Rhea Creek (personal communication: K. Ramsey, USFS, January 2004). Although Oregon forest practices are being followed, these are less stringent than USFS practices, and the harvest may affect water quality in Rhea Creek (personal communication: K. Ramsey, USFS, January 2004).

Table 12. Timber sales and harvest rate in the Umatilla/Willow subbasin (Umatilla National Forest 2000).

Period of Harvest	Timber Sales (acres)	Harvest Rate (ac/yr)
1990-1994 (5 years)	4,091	818
1980-1989 (10 years)	17,572	1,757
1970-1978 (9 years)	26,374	2,931
1960-1969 (10 years)	6,963	693
1958-1959 (2 years)	983	492

One management practice involved with timber harvesting is fire suppression. This practice has had a significant impact on the ecology of forests in the Umatilla/Willow subbasin. These impacts have been summarized in an ecosystem analysis of the Upper Umatilla River and Meacham Creek watersheds conducted by the Umatilla National Forest (2001):

> Like most areas in the Blue Mountains, fire suppression has strongly influenced the structure and composition of the forest vegetation within the watersheds. Most significantly, early seral species such as ponderosa pine, lodgepole pine and western larch have been replaced by late seral and climax species like Douglas-fir and grand fir. In addition, forest structure has changed from predominantly low density, single story to high density, multi-story. Forests have also colonized grasslands, resulting in an overall decline in herbage production. There has been a substantial loss of hardwood tree species, particularly in riparian areas, resulting in a loss of forest tree diversity. The result of these vegetation changes has been an increase in fuel loads to the extent that forested areas are at significantly higher risk of experiencing stand replacing wildfires as compared to historical conditions.

Another impact of the change in dominant tree species from pines to firs is that firs are not as resistant to insect attacks and disease outbreaks as pines, and thus, areas where fire has been suppressed are more susceptible to timber loss from these sources than they were historically (Langston 1995).

The impact that forestry practices have had on wildlife in the Umatilla/Willow subbasin has not received extensive study. However, several wildlife species are dependent upon large structure ponderosa pine forests, which, while historically abundant in the subbasin, have become scarce because of forestry practices including fire suppression. These wildlife species include White-headed Woodpeckers, which have become scarce in the subbasin presumably because of destruction of appropriate habitat (Gilligan et al. 1994), and Flammulated Owls. Historical timber harvests in steep headwater portions of the Umatilla subbasin have likely also affected aquatic systems; deforestation can reduce riparian and water storage capacities, and increase runoff rates, increasing sedimentation in streams (Shaw and Sexton 2000).

Livestock Grazing: Livestock grazing in the subbasin dates back to pre-European settlement times. The local tribes, particularly the Cayuse, owned large numbers of horses. Around 1870, according to early reports, one Indian chief owned a band of 5,000 horses (Harper et al. 1948). As early as 1811, Wilson Price Hunt noted that there were 2,000 horses for 34 Indian families at just one winter encampment adjacent to the Umatilla River (Langston 1995). Accounts from tribal elders agree that the number of horses in the subbasin was quite large (CTUIR 2004b):

> Tribal elders tell us that in those days the Indians had thousands and thousands of horses and that they needed areas for them to graze. There wasn't enough grazing area so they had to spread the horses out. The Cayuse used to graze horses all through the Umatilla Basin, across the Columbia River on the Horse Heaven Hills all the way to

> Hanford to the north, on the east side of the Blue Mountains from the Grande Ronde country all the way to Huntington, to the John Day River country in the south and all the way to the Cascades in the west

These large tribal horse herds likely impacted the native grasses of the region; however, this impact has not received study.

Livestock raising was the first important agricultural practice in the subbasin for white settlers. Horses, cattle and sheep have all been raised over the past 100 years, but their relative importance has changed. Sheep were the predominant livestock at the beginning of the 20th century; however, by the late 1950s, sheep numbers greatly decreased and cattle became the predominant livestock (Figures 26 and 27). The total number of livestock in Umatilla and Morrow counties was quite large in the early 1900s, often totaling over 250,000 head of sheep (Figures 26 and 27). However, in the early 1930s the numbers began to decline and currently there is approximately 90,000 head of livestock in each county.

While the number of livestock has decreased greatly over the last 70 years in the subbasin, it still is a primary or secondary land use in some watersheds. These watersheds include Spring Hollow Creek, Mission Creek, Buckaroo Creek, Squaw Creek, McKay Creek, Moonshine Creek and Cottonwood Creek (Shaw and Sexton 2000).

The impact of livestock grazing on native vegetation is quite extensive and has a long history. Brown (1947) reported that by the 1890s, native grasses, though naturally recuperative under conservative use, were partially destroyed by unregulated grazing by sheep and cattle. Problems associated with overgrazing include 1) reduction of the total amount of native vegetation, 2) replacement of native vegetation with plants of low forage value and/or exotic species and 3) reduction of surface cover, resulting in increased surface and wind erosion (Shelford and Hanson 1947). Exotic vegetation that has been introduced into the subbasin as a possible result of livestock grazing includes cheatgrass and yellow starthistle.

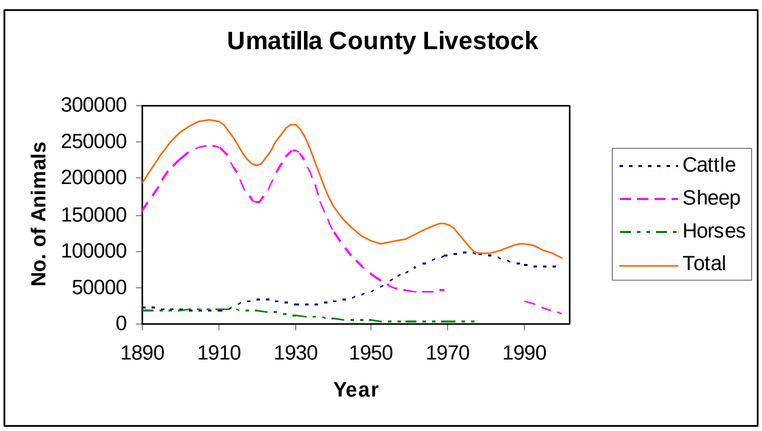


Figure 26. The number of livestock over the past century in Umatilla County (Umatilla National Forest 2004; USDA NASS 2004).

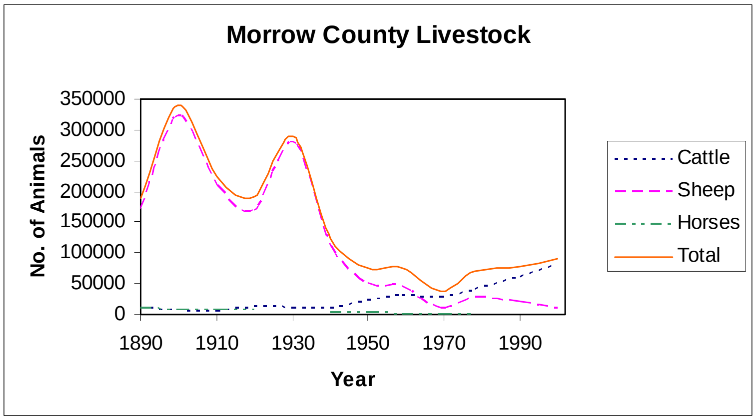


Figure 27. The number of livestock over the past century in Morrow County (Umatilla National Forest 2004; USDA NASS 2004).

Livestock grazing can also have significant impacts on rivers and streams and their biota. This impact comes largely from the loss of riparian vegetation in areas in which livestock have access to riparian areas. With loss of riparian vegetation come increased stream temperatures from lack of shade, loss of input of organic matter from the riparian vegetation to the stream (an important energy source for aquatic food webs), and unstable streambanks which are vulnerable to erosion and increase the input of fine sediment into the stream (Waters 1995; NRC 2002). In the Umatilla/Willow subbasin livestock grazing has been identified as having important impacts on bull trout habitat in the Umatilla River mainstem from the city of Pendleton to the forks, within the Meacham Creek drainage, and within the North Fork of the Umatilla River (associated with livestock trespasses) (USFWS 2004). In addition, livestock grazing in the Wildhorse Creek watershed has contributed to poor water quality and loss of floodplain function (Shaw and Sexton 2000).

Livestock grazing can also affect terrestrial wildlife. The extirpation of the Rocky Mountain bighorn sheep from the Umatilla/Willow subbasin and the rest of the Oregon by the 1940s may have been partially due to unregulated domestic livestock grazing and the spread of parasites and disease carried by domestic livestock to bighorn sheep (ODFW 2003b). Excessive livestock grazing in riparian areas can eliminate vegetative structure that are important habitat features for birds such as the Red-Eyed Vireo (Altman 2000, Altman and Holmes 2000). Livestock grazing may also contribute to increased rates of brood parasitism by Cowbirds, which often forage near livestock (Goguen and Matthews 2001). Brood parasitism occurs when Cowbirds lay their eggs in the nests of other bird species. The Cowbird offspring is then raised by its "adopted" bird mother, often to the detriment of her own offspring. Parasitism by Cowbirds has been found to significantly decrease the reproductive output of some bird species, particularly in fragmented landscapes (Robinson et al. 1995).

Settlement/Urbanization: The first human inhabitants of the Umatilla/Willow subbasin were Native Americans. The Umatilla/Willow subbasin is part of the historic homelands of the Walla Walla, Cayuse, and Umatilla Indian Tribes. Historically, Native-Americans relied heavily on hunting, fishing, and gathering. This lifestyle changed as large numbers of white settlers moved into the Umatilla/Willow subbasin in the mid 1800s. Conflict arose when the federal government gave Native American lands in the Oregon Territory to settlers. This conflict ended, for the most part, with the Treaty of 1855. Under the Treaty, the Tribes ceded 6.4 million acres of their lands in northeast Oregon and southeast Washington to the United States and reserved rights for fishing, hunting, gathering foods and medicines, and pasturing livestock (CTUIR 2004). The Tribes also reserved 510,000 acres on which to live. The Treaty was subsequently ratified by Congress on March 8, 1859. The Umatilla Indian Reservation is located within the Umatilla/Willow subbasin, including the CTUIR government headquarters at Mission, Oregon. Today, there are over 2,400 tribal members, and the lands of the CTUIR encompass 172,000 acres (158,000 acres just east of Pendleton, Oregon plus 14,000 acres in the McKay, Johnson, and McCoy Creek areas southeast of Pilot Rock, Oregon) (CTUIR 2004). Approximately 75,500 acres of the reservation are privately owned.

The three largest cities in the Umatilla/Willow subbasin were all established before 1910. The city of Umatilla was incorporated in 1864, Pendleton was incorporated in 1880, and Hermiston was incorporated in 1907. In 2000, approximately half of Umatilla County's population lived in these three cities, with 16,354 people in Pendleton, 13,154 in Hermiston, and 4,978 in Umatilla. Boardman, the largest city in Morrow County, with 2,855 people in 2000, was incorporated in 1927. Population in the subbasin is expected to grow by about 10,000 people in the next 10 years (Umatilla River Subbasin Local Agricultural Water Quality Advisory Committee 1999). Urbanization has affected about 1% of the land in the Umatilla/Willow subbasin, and the impacts of urbanization, including effects on water flow and water quality, and the construction of dikes, levees, and rip-rapped banks, are described in 3.1.1.9.

Several efforts are underway in the Umatilla/Willow subbasin to reduce negative impacts of urbanization on stream water quality and water flow conditions. For example, Pendleton has a program on hazardous materials training for public works employees that will enhance and protect riparian areas and streams by preventing runoff from hazardous chemical spills that could convey pollutants into these systems (see Section 4.3.1 for more details). Pendleton is also working on a water supply development program that will not only improve and stabilize drinking water supplies for residents of the city and ensure that drinking water meets federal Safe Drinking Water Act standards, but will also improve the quantity and quality of in-stream flows of the Umatilla River, protect groundwater from over drafting, and lead to the development of a surface water supply for future economic development. The projects that make up this program include building a new, membrane filtration water treatment plant; building a new intake/pump station on the Umatilla River; transferring City water rights from current locations to the new intake/pump station location; and modifying city wells for storing and recovering the filtered water from the new water treatment plant in a process known as "aquifer storage and recovery." More details of this project are described in Section 4.3.1.

Transportation: The earliest routes of transportation in northeastern Oregon were formed by Native Americans of the Columbia Plateau, as they traded goods with tribes west of the Cascades and east of the Bitteroot Mountains. Later, early white settlers established major transportation routes in the Umatilla/Willow subbasin as they moved to the western United States in wagon trains. The most extensive and famous of these routes was the Oregon Trail, which extended through the Blue Mountains, down to the banks of the Umatilla River where Pendleton now stands, and through the lower basin of the Umatilla/Willow subbasin. The first wagon train rolled onto the Trail in 1841 and emigrants eventually wore the road into a great highway, in some places a hundred feet wide and ten feet deep. Ruts of the Oregon Trail are still visible today at some locations in the subbasin. Estimates from 1842 to 1849 indicate a total of 12,287 immigrants moved through CTUIR tribal homelands (CTUIR 2004). The movement of large numbers of settlers into the area had a devastating effect on Native Americans. Diseases introduced by settlers killed up to 50% of area Native Americans; resources, including fish and wildlife, were degraded and depleted; and, eventually, most tribal lands were lost (CTUIR 2004).

Further development of transportation corridors in the Umatilla/Willow subbasin continued with the coming of the railroad in 1881, which opened the area to the development of dryland wheat farming. Many past and current railroad routes follow the Umatilla River and its tributaries and Willow Creek. For example, the Union Pacific Railroad runs almost the entire length of Willow Creek from near the mouth to Heppner and nearly the entire length of the Umatilla River mainstem from near its mouth to Meacham Creek (RM 79). Abandoned railroads of [0]Union Pacific and Northern Pacific, which ran out of Pendleton to Adams/Athena and Helix /East Juniper Canyon respectively until 1978, still exert a major influence on Wildhorse Creek and its tributaries (personal communication: J. Williams, USDA-ARS, January 2004), as described in Section 3.1.1.9.

Roads and highways have also continued to increase in the Umatilla/Willow subbasin. Although first used by horse drawn vehicles, roads became more common with the widespread use of the automobile, and with the development of urban areas, such as the cities of Pendleton, Umatilla, and Hermiston. In addition, the timbering industry resulted in a high density of roads in many of the forested areas in the subbasin (Umatilla National Forest 2001). Both paved and gravel roads are often constructed along waterways in the Umatilla and Willow Creek subbasin. For example, State Highway 74 runs along most of Willow Creek from near the mouth to Heppner and asphalt county roads run adjacent to the Umatilla River mainstem from near its mouth to Meacham Creek (RM 79).

Transportation corridors can significantly impact hydrology and ecology by increasing 1) the loss of riparian vegetation, 2) stream water temperatures, 3) surface water run-off into stream channels, and 4) flashiness in stream flow. These effects are described in more detail in Section 3.1.1.9.

Water Development: Water development for irrigation has had a large impact on both the hydrology and ecology of the Umatilla/Willow subbasin. Irrigated agriculture is served by six diversion dams found in the lower Umatilla River (from RM 4.1 to RM 32.4) and two reservoirs, Cold Springs and McKay Creek.

In Umatilla County, irrigation began in 1870 but only in limited areas near river and stream bottoms. Livestock, horses, cattle, and sheep, were the main agricultural practice at this time. In 1876 some area agriculturalists began growing grains. The first large irrigation canal, the Hinkle Ditch, was not constructed until 1903 in Umatilla County. During this time the United States Reclamation Service (now the Bureau of Reclamation, BOR) engineers began investigating the development of the "Umatilla Basin Project" and their early plans called for the irrigation of 60,000 acres of land and the construction of a reservoir (Stene 1993). In addition, two other private irrigation ventures took shape, the Furnish Ditch Company and the Western Land and Irrigation Company (BOR 2003).
In 1905 the Secretary of the Interior authorized the Umatilla Basin Project and provided the United States Reclamation Service with one million dollars to begin construction on an irrigation system (Stene 1993). The first steps involved constructing the Feed Canal system and Cold Springs Dam, which would produce the reservoir filled by the Feed Canal. Construction on this system began in 1906 and finished in 1908. Cold Springs Dam is 100 feet high with a crest length of 3450 feet and the reservoir holds 50,000 acre-feet of water. Cold Springs reservoir was used as an irrigation supply in the summer by local farmers. However, it did not meet the demand for water and subsequently two other diversion systems were completed by the U.S. Reclamation Service, Three Mile Falls Diversion Dam and West Extension Canal system in 1914 and Maxwell Diversion Dam and canals in 1916. Irrigation was further augmented by the Reclamation Service with the construction of McKay Dam on McKay Creek. Construction on the dam began in 1923 and the project was finished in 1927. McKay Dam is 165 feet high with a crest length of 2700 feet and the reservoir holds 73,800 acre-feet of water.

The private irrigation ventures included the Furnish Ditch Company, which was started in 1903. By 1907 the company had built a diversion dam east of the town of Echo, and two years later finished a small offstream storage reservoir to provide additional summer water (BOR 2003). By 1925 the reservoir had filled with silt and was later destroyed in 1934 (Swanson 1950). The diversion however, remained and is currently operated by the Stanfield Irrigation District. The other private venture, Western Land Irrigation Company, was started in the 1890s. It is currently the Westland Irrigation District and operates the Westland Diversion Dam.

These irrigation diversion projects and McKay Reservoir have had important impacts on the hydrology of the Umatilla subbasin. During the summer months, discharge in the lower Umatilla River decreases with water withdrawals and shows slight increases with irrigation return water (Figure 28). Water is released from McKay Reservoir at RM 50.5 during peak irrigation periods. The impact of storage of water in McKay Reservoir and releases of water during the summer months is to lower mean monthly instream flows during the winter when water is stored and increase flows during the summer when stored water is used for irrigation (Figure 29).

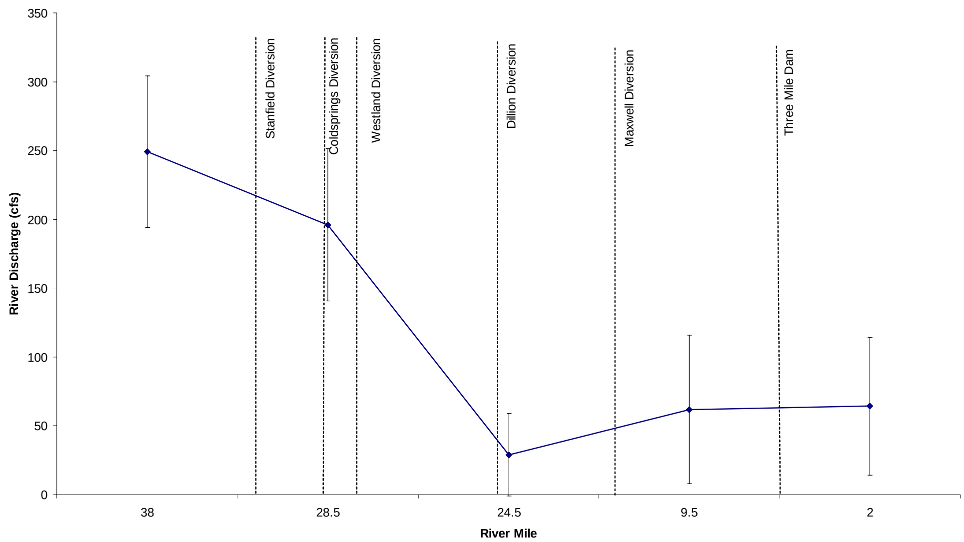


Figure 28. Discharge at 5 USGS gauging stations. Data are summer averages for the months of July, August, and September for the years 1994-2000 (USGS 2004).

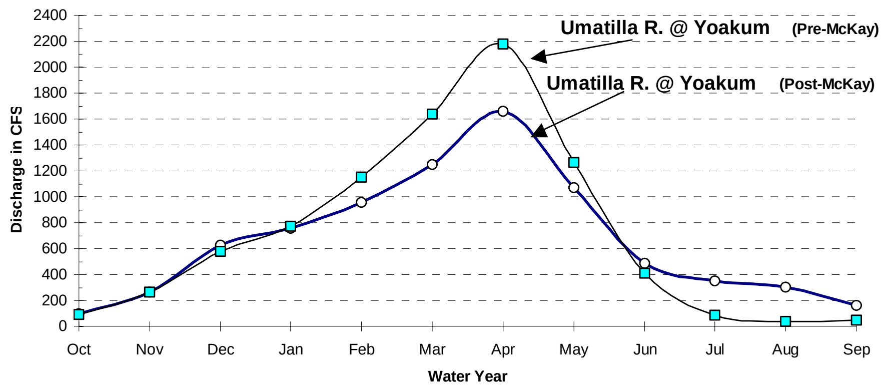


Figure 29. The impact of McKay Reservoir releases on the Umatilla River at Yoakum (RM 37.7).

The hydrology of Willow Creek is also greatly influenced by irrigated agriculture as well as the construction of the Willow Creek Dam. Irrigated agriculture began in the late part of the 19th century; the earliest water rights date back to 1870 (personal communication: M. Ladd, OWRD, April 2004). Currently, total annual flows are reduced by approximately 23% (from 30,000 acre feet to 23,000 acre feet) due to extensive irrigation withdrawals (Willow Creek Local Advisory Committee et al. 2003). Willow Creek Dam was constructed on Willow Creek upstream of Heppner (at RM 55.5) in 1983. It is 160 feet high and has a maximum storage capacity of 14,000 acre feet (Willow Creek Local Advisory Committee et al. 2003). The Willow Creek Dam was constructed mainly as a flood control structure, and not for irrigation. However, a permit issued by OWRD does allow the storage of 3,500 acre-feet for irrigation purposes (personal communication: M. Ladd, OWRD, April 2004). As such its influence on downstream hydrology is different than diversions built for irrigation purposes. During late winter and spring, when reservoir waters rise above the maximum pool elevation, water is released at a maximum rate of 500 cfs. During the dry season, discharge is generally less than 10 cfs. In the summer the reservoir is maintained above the flood control level to accommodate recreational activities. However, in mid-October the reservoir is reduced to the winter flood control level and maintained at that level during the winter by releasing larger amounts of water as needed (Willow Creek Local Advisory Committee et al. 2003). Therefore, the hydrology in the lower sections of Willow Creek below the dam is characterized by no natural floods, a regular fall peak in flow during reservoir draw-down, and constant high winter and spring flows.

In the Umatilla River, the dewatering of reaches and the creation of passage barriers that were necessary for irrigation activities resulted in the extirpation of Chinook and coho salmon stocks and the endangerment of the steelhead stock in the 1920s (Phillips et al. 2000). In response to the need for continued irrigation and the desire to restore steelhead and salmon populations a unique coalition formed in the 1980s between the CTUIR and local irrigators. With the help of the BOR, Bonneville Power Administration (BPA), Oregon Water Resources Department (OWRD), and ODFW, this coalition has made substantial progress in recovering salmon populations in the subbasin without harming irrigated agriculture. The coalition led to the development of the Umatilla Basin Project Act (102 Stat. 2791, Public Law 100-557), which was passed by Congress on October 28, 1988.

The Act allows irrigators to exchange Umatilla River water for Columbia River water. This allows water historically appropriated for irrigation to remain in the Umatilla River during times when flows are critical for steelhead and salmon. Water exchanges are made possible by the construction of exchange facilities, which include pumping plants that take water out of the Columbia River and a series of pipelines that deliver that water to the irrigation districts. Two phases of the Act have been completed and a third phase has been proposed. Phase I involves exchange of water with the West Extension Irrigation District, which withdraws water at Three Mile Falls Dam. The purpose of this exchange is to provide target instream flows in the lower 3 miles of the Umatilla River. Construction of the Phase I exchange facilities began in 1991 and the first exchange occurred in 1993. The primary operational months for this exchange are critical months for salmon and steelhead adult returns and juvenile outmigration: May, June, September, and October. An average annual exchange of 9700 acre-feet is made under this Phase.

Phase II involves exchanges of water with the Hermiston and Stanfield Irrigation Districts. Historically, Hermiston Irrigation District diverted water from the Umatilla River off season (November-May) to fill Cold Springs Reservoir. The purpose of the exchange with the Hermiston District is to provide additional instream flow during critical months of adult returns and juvenile outmigration below the Feed Canal Diversion (RM 28). This exchange began in 1995 and involves on average an annual exchange of 11,200 acre-feet of water. Stanfield Irrigation District historically diverted both live flow and McKay irrigation releases at the Stanfield diversion (RM 32). The purpose of this exchange is to provide additional instream flow during the irrigation season and to cool water temperatures through cold water releases from McKay Reservoir. A partial exchange with Stanfield Irrigation District began in 1996 and full exchange started in 1999. Annually, an average of 18,600 acre-feet of water is exchanged with Stanfield Irrigation District under full operation[1].

While these phases have helped the recovery of the steelhead population and assisted the reintroduction of Chinook and coho populations in the Umatilla River, irrigation still removes approximately half of the instream flows during the summer months (June – September) (ODEQ et al. 2001). The proposed Phase III of the Umatilla Basin Project would involve a complete exchange of water in the Umatilla River used by Westland Irrigation District with Columbia River water and would allow nearly all of the Umatilla River surface water to remain instream.

As stated above, water development for irrigation was one of the main influences on the extirpation of Chinook and coho salmon and the endangerment of steelhead. Further water development has had more positive impacts on these fish. Habitat surveys have shown that that hypolimnetic releases of cool water from McKay Reservoir during early summer months keep water temperatures suitable for salmonids in areas between the McKay Creek confluence (RM 50.5) and Westland dam (RM 27) (Contor et al. 1997). This discharge, however, is not continuous during the summer, and water temperatures can become extreme when releases are stopped. In addition, warmer epilimnetic waters can be discharged upon the depletion of the hypolimnion, further contributing to unsuitable habitat conditions (Contor et al. 1997).

In addition, the early construction of diversion dams led to problems with passage, entrainment, and injuries to fish at points of diversion. In an effort to address this problem, outdated juvenile and adult fish passage facilities were reconstructed between 1988 and 1994 at five major irrigation dams on the lower Umatilla River. Reconstructions followed design standards set by the National Marine Fisheries Service (NMFS). ODFW conducted studies to evaluate screen efficiency and migration survival of juvenile salmonids between 1988 and 1994 (Knapp and Ward 1990, Hayes et al. 1992, Cameron and Knapp 1993, Cameron et al. 1994, 1995, 1997). From 1991 – 1995, most test fish passed through the updated bypass facilities and fish ladders with negligible injury (Knapp et al. 2000).

In addition, water development might also have had an important impact on non-salmonid fish species in the subbasin. Summer fish communities in the lower Umatilla mainstem include exotics whose abundance in the river may be aided by low discharge and high temperatures. These species include smallmouth bass, largemouth bass, carp, bluegill, yellow crappie, black crappie, channel catfish, and mosquitofish. It is unclear what impact these exotic fish have on the ecology of the river system including the abundance of native species.

Finally, while little work exists on the impacts of water development on wildlife, waterfowl numbers have increased recently in the subbasin. While this has been

[1] Information in this and the preceding paragraph is from BOR 1998.

attributed to the construction of the John Day and McNary dams and their reservoirs (Lloyd et al. 1983), the Cold Springs and McKay Reservoirs most likely contribute to the increase in these species within the Umatilla/Willow subbasin as well.

3.1.4 Regional Context

3.1.4.1 Relation to the Columbia Basin

The Umatilla/Willow subbasin is located near the center of the Columbia basin, in northeastern Oregon (Figure 30). It is of intermediate size compared to the other 61 subbasins delineated by the NWPCC, and has a total area of 3,714 square miles, which accounts for approximately 1.7% of the total area of the Columbia basin in the United States. The Umatilla River flows into the Columbia River at RM 289 and Willow Creek enters at RM 253. Three major Columbia River dams (the John Day, The Dalles, and Bonneville dams) are downstream of these confluences.

3.1.4.2 Relation to the Ecological Province

The NWPCC has divided the subbasins of the Columbia Basin into 11 ecological provinces based on similarities in climate and geology (NWPCC 2000). The Umatilla/Willow subbasin is one of ten subbasins grouped in the Columbian Plateau ecological province (Figures 30 and 31). The Columbia Plateau province is the largest of the 11 ecological provinces and is defined as the Columbia River and associated watersheds between The Dalles and Wanapum dams on the Columbia River and Ice Harbor Dam on the Snake River. Within the Columbia Plateau province, the Umatilla/Willow subbasin is bordered to the north by the Walla Walla subbasin, to the south by the John Day subbasin, and to the west by Columbia Lower Middle subbasin (Figure 31). The Grande Ronde, a subbasin in the Blue Mountain province, lies to the east of the Umatilla/Willow subbasin.

3.1.4.3 Relation to Other Subbasins in the Province

Because subbasins in the Columbia Plateau province are grouped together based on similarities in climate and geology (see Sections 3.1.1.3 and 3.1.1.4 for description), almost all of the subbasins in the province (with the exception of the John Day) were historically dominated by interior grasslands and/or shrub-steppe habitats (IBIS 2004). Currently, the Umatilla/Willow subbasin is dominated by agricultural lands, as are all other subbasins in the province with the exception of the Deschutes, John Day, and Yakima subbasins (IBIS 2004). Thus, like most other subbasins in the province, agriculture plays a key role in the economy and culture of the Umatilla/Willow subbasin, and, as is typical of many agricultural areas, human population densities are generally low. The majority of land in the Umatilla/Willow subbasin (>85%) is privately owned (Table 2), as is the case with other subbasins in the province (e.g., the Walla Walla, John Day, and Deschutes subbasins). The importance of agriculture and the arid nature of the area also results in a problem common in most other subbasins in the province: water is over-appropriated and is required for multiple, sometimes competing purposes. Like most other subbasins in the province wildland recreation, including fishing, hunting, boating, and hiking, is also an important component of the economy and culture of the Umatilla/Willow subbasin.

The fish and wildlife of the Umatilla/Willow subbasin are also related to other subbasins in the province. For example, bull trout of the Walla Walla, John Day, and Umatilla/Willow subbasins belong to the same gene conservation group. In addition, the Umatilla/Willow, John Day, Yakima, and Walla Walla subbasins share the same Middle Columbia River Steelhead evolutionarily significant unit (ESU). Many of the terrestrial wildlife species found in the Umatilla/Willow subbasin are also found in other subbasins in the province (IBIS 2004), with mobile species often moving between subbasins in the province. Like some of the other subbasins in the province, the Umatilla/Willow subbasin also has significant remnants of high quality shrub-steppe wildlife habitat. Fish and wildlife in the Umatilla/Willow subbasin face many of the same problems that threaten species in other subbasins of the province, both from within and outside of the subbasin (see Sections 3.1.1.9, 3.3, and 3.5).

3.1.4.4 Unique Qualities of the Subbasin

Although the Umatilla/Willow subbasin is similar in many ways with the other subbasins in the province, it is also unique in other ways. Perhaps most notable is the way in which stakeholders in the Umatilla/Willow subbasin with different interests have worked together to improve fish habitat in the Umatilla River through the Umatilla Basin Project. The project itself is unique, in that it allows managers to artificially regulate hydrographs with stored and exchanged water to mitigate water quality and quantity issues limiting fish habitat (see Section 3.1.3.2 for thorough description). Historically, the subbasin's political, economic and ecological challenges often arose in the classic "fish versus agriculture" paradigm. This situation was exacerbated by the federal government, which "twice promised" waters of the river: first to local Native American Tribes by treaty and later to pioneer farmers by contract. However, substantial progress was made in efforts to recover salmon populations and improve salmon habitat on the Umatilla River because of an informal alliance between CTUIR and growers in the Umatilla River irrigation districts in the 1980s. Through this alliance, and with the help of the BOR, BPA, OWRD, and ODFW, the first two phases of the Umatilla Basin Project were implemented, a process that brought water from the Columbia River to be used for irrigation, and thus allowed an equal amount of Umatilla River water to remain in-stream to aid fish migration. Although a third phase has yet to be completed, the alliance continues and has the long-term goals of 1) restoring native salmonid populations, 2) creating a river habitat that allows for sustainable natural reproduction with adequate adult returns to serve tribal needs and provide a sport fishery, and 3) provide water needed for agriculture.

The Umatilla/Willow subbasin is also unique in other ways related to water resources and the presence of salmonid species. Extirpated Chinook and coho salmon have been reintroduced to the subbasin, and their production, as well as steelhead production, has been increased through hatchery supplementation. Natural production of steelhead is increasing as well; returns of Middle Columbia River ESU natural summer steelhead adults are increasing more rapidly in the Umatilla River than in the Walla Walla or John Day subbasins (Contor 2003). The Umatilla/Willow subbasin also provides important habitat for many salmonids. Although the subbasin contains only about 1.5% of all the river miles in the U.S. portion of the Columbia basin and 6% of all the river miles in the Columbia Plateau province (Streamnet 2004), it provides a disproportionate amount of salmonid habitat (Table 13).

The terrestrial environment in the Umatilla/Willow subbasin is also unique in that it contains some of the largest remaining tracts of shrub-steppe habitat in the Columbia Plateau in Oregon (see Section 3.2.4.2).

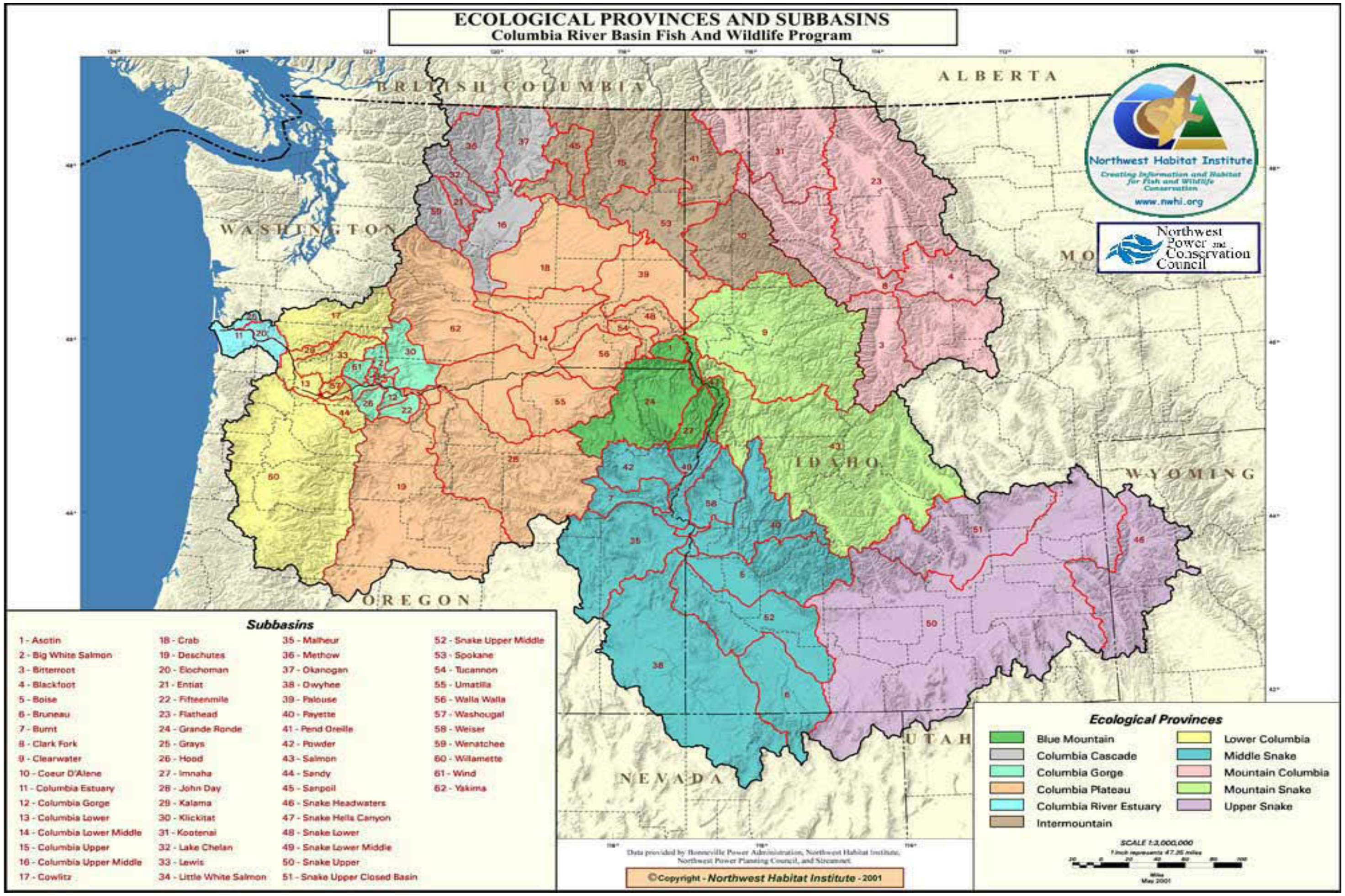


Figure 30. The 62 subbasins and 11 provinces of the Columbia basin as delineated by NWPCC (NWHI 2003).

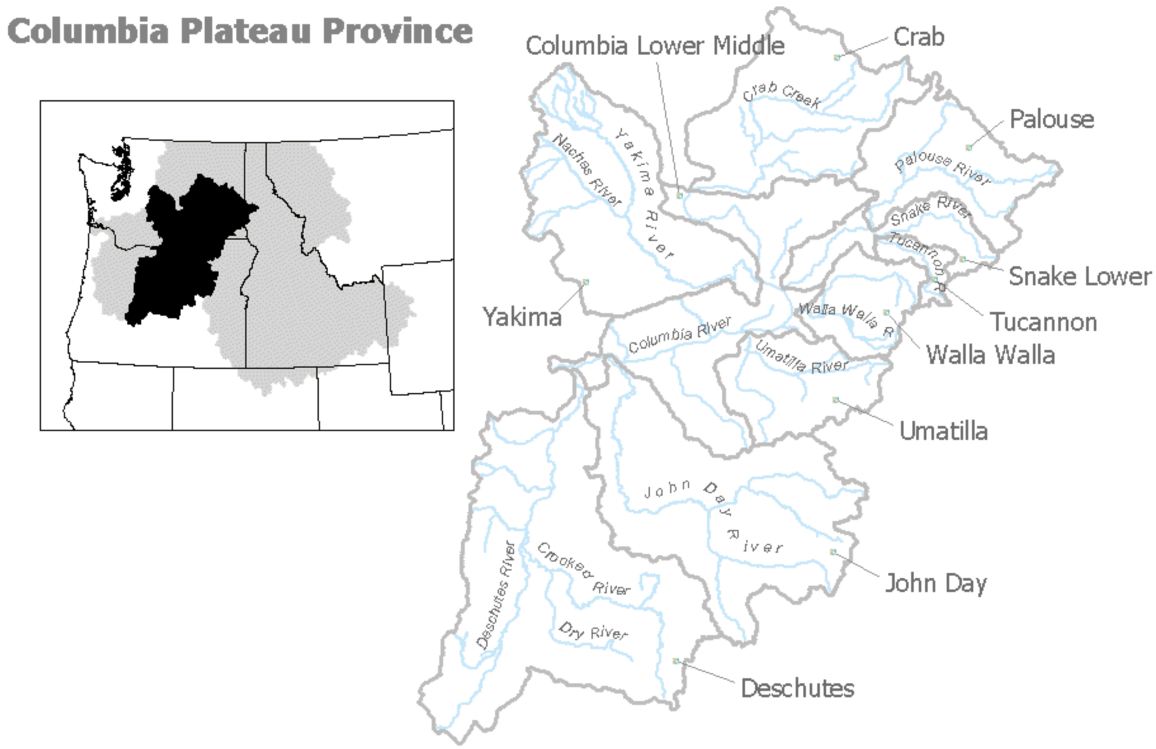


Figure 31. The ten subbasins forming the Columbia Plateau Province.

3.1.4.5 NOAA Fisheries Evolutionarily Significant Units[1]

More than 50 different ESUs of West Coast salmon and steelhead have been identified in Washington, Oregon, California and Idaho. An ESU is a geographic delineation of fish used to distinguish individual populations of salmon or steelhead that share common genetic, ecological and life history traits. Within an ESU there may be multiple populations of demographically independent groups of fish that spawn during specific seasons and within specific waterbodies, but do not interbreed with fish from another group.

The interior Columbia River basin is currently home to 12 different anadromous salmonid ESUs, belonging to three different species: Chinook salmon (*Oncorhynchus tshawytscha*), sockeye salmon (*O. nerka*), and steelhead trout (*O. mykiss*). Since 1991, seven of these 12 ESUs have been listed as threatened under the Endangered Species Act (ESA) because of dramatic declines in abundance and loss of habitat.

The Umatilla/Willow subbasin is located within the Middle Columbia River (MCR) Steelhead ESU. Other subbasins within the Middle Columbia River Steelhead ESU are the John Day, Upper Yakima, Lower Yakima, Naches, Klickitat, Lower Deschutes, Trout, Willow, and the Walla Walla subbasins. The MCR Steelhead ESU is the only

[1] Large portions of the text in this section were written by N. Berwick of NOAA Fisheries and are used with permission to D. Wooster and J. Phelps from the author.

NOAA Fisheries ESU in the subbasin. The Middle Columbia River steelhead was listed as threatened on March 25, 1999 (64 FR 14517), critical habitat was designated on February 16, 2000 (65 FR 7764), and protective regulations were adopted on July 10, 2000 (65 FR 42422). The Middle Columbia River ESU includes all naturally spawned populations of steelhead in streams from above Wind River, Washington, and Hood River, Oregon, upstream to, and including, Yakima River, Washington.

3.1.4.6 USFWS Designated Bull Trout Recovery Units

The Umatilla-Walla Walla Recovery Unit is one of 22 recovery units designated for bull trout in the Columbia River Basin (USFWS 2004). The two subbasins were combined into one recovery unit based on the conclusion that their bull trout are genetically similar, or fall within the same gene conservation group, as defined by ODFW (Kostow 1995; Spruell and Allendorf 1997). Although John Day River bull trout also fall within the same gene conservation group, they have been separated into their own recovery unit for logistical and administrative reasons (USFWS 2004). In the Umatilla-Walla Walla Recovery Unit, two local populations have been identified in the Umatilla Subbasin – the Upper Umatilla population and the Meacham Creek population. The Upper Umatilla population includes bull trout in both the North Fork and South Fork Umatilla Rivers. The viability of the Meacham Creek population is undetermined because of the low number of redds and fish observed in recent years.

3.1.4.7 Summary of Out-of-Subbasin Environmental Conditions on Fish and Wildlife

Environmental conditions external to the Umatilla/Willow subbasin impact both fish and wildlife species in the subbasin. Anadromous fish leaving the subbasin as juveniles and returning as adults are affected by multiple aspects of the aquatic environments they encounter in that journey, including three major dams on the Columbia River, and variable estuary and ocean conditions. Passage barriers, poor water quality, flow issues, and predation are some of the obstacles facing these fish outside the subbasin. In addition, salmon and steelhead abundances are influenced strongly by ocean conditions including the PDO. Likewise, highly mobile terrestrial wildlife species are also affected by out-of-subbasin conditions. These may range from problems such as loss of habitat connectivity in adjacent subbasins to deforestation of wintering habitat in South America. A detailed and quantitative discussion of out-of-subbasin effects on aquatic focal species and terrestrial focal species and their habitats can be found in Section 3.3.

Table 13. Comparison of amount of habitat used by selected fish species in the U.S. portion of the Columbia basin, in the Columbia Plateau province, and in the Umatilla/Willow subbasin (Streamnet 2004). Highlighted percents in the last two columns of the table show instances in which the percent of habitat used by fish is twice or greater than predicted based on river miles alone (see text for further explanation).

Fish Species Use Type	**Habitat in US portion of Columbia Basin** (in stream miles)	**Habitat in Columbia Plateau Province** (in stream miles)	**Habitat in Umatilla/Willow Subbasin** (in stream miles)	**Percent of Columbia Basin Habitat Found in Umatilla/Willow Subbasin**	**Percent of Columbian Plateau Province Habitat Found in Umatilla/Willow Subbasin**
Spring Chinook					
Primarily spawning and rearing	4,191.9	543.1	44.1	1%	8%
Primarily rearing and migration	2,728.6	843.9	93.4	3%	11%
Primarily migration	1,897.0	573.9	0	0%	0%
Total use*	8,839.5	1,976.8	137.5	2%	7%
Fall Chinook					
Primarily spawning and rearing	1,269.7	415.2	87.0	7%	21%
Primarily rearing and migration	284.2	27.1	0.3	<1%	<1%
Primarily migration	1,090.0	428.7	0	0%	0%
Total use*	2,643.9	871.1	87.3	3%	10%
Coho					
Primarily spawning and rearing	1,527.3	146.1	103.5	7%	71%
Primarily rearing and migration	770.2	39.7	37.5	5%	94%
Primarily migration	1,376.3	345.3	0	0%	0%
Total use*	3,675.5	531.0	141.0	4%	27%
Steelhead					
Primarily spawning and rearing	12,060.1	4,018.5	241.6	2%	6%
Primarily rearing and migration	1,455.2	494.5	169.2	12%	34%
Primarily migration	2,954.6	1,250.9	0	0%	0%
Total use*	16,599.4	5,888.6	413.5	2%	7%
Bull Trout					
Primarily spawning and rearing	1,618.4	428.1	11.1	<1%	3%
Primarily rearing and migration	736.3	313.2	64.5	9%	21%
Primarily migration	1,326.4	122.2	22.0	2%	18%
Total use*	6,633.6	882.4	97.6	1%	11%

* may include stream miles that are used by fish, but the nature of the use is unknown; thus, "total use" may not reflect the sum of the primary uses listed

3.2 Focal Species Characterization and Status

3.2.1 Fish, Wildlife, Plants, and Invertebrates of Ecological Importance

3.2.1.1 Species Designated as Threatened, Endangered, or Sensitive

Two fish species and five terrestrial wildlife species found in the Umatilla/Willow subbasin are currently listed as threatened or endangered by Oregon and/or the federal government (Table 14). No threatened or endangered plant or invertebrate species are known to occur in the Umatilla/Willow subbasin. Three wildlife species in the subbasin are federal candidate species, meaning that there is sufficient information on the biological vulnerability of and threats to these species to support proposals to list them as endangered or threatened (Table 15). In addition, three plant species in the subbasin are listed by the Oregon Department of Agriculture as candidate species for threatened and endangered status under the Oregon Endangered Species Act (Table 16).

Table 14. Fish and wildlife species of the Umatilla/Willow subbasin listed as threatened or endangered at the state or federal level (ODFW 2003a, USFWS 2003).

Common Name	Scientific Name	Status
Fish:		
bull trout [1]	*Salvelins confluentus*	US: Threatened
summer steelhead [2]	*Oncorhyncus mykiss*	US: Threatened
Wildlife:		
Bald Eagle	*Haliaeetus leucocephalus*	OR and US: Threatened
Canada lynx	*Lynx canadensis*	US: Threatened
Peregrine Falcon	*Falco peregrinus*	OR: Endangered
Washington ground squirrel	*Spermophilus washingtoni*	OR: Endangered
wolverine	*Gulo gulo*	OR: Threatened

[1] listing unit is the Columbia River Distinct Population Segment
[2] listing unit is the Middle Columbia River ESU

Table 15. Wildlife species of the Umatilla/Willow subbasin that are candidates for federal listing (USFWS 2003).

Common Name	Scientific Name
Columbia spotted frog	*Rana luteiventris*
Washington ground squirrel	*Spermophilus washingtoni*
Yellow-billed Cuckoo	*Coccyzus americanus*

Table 16. Plant species of the Umatilla Willow subbasin that are candidates for state listing (ONHP 2001).

Common Name	Scientific Name
Columbia yellow-cress	*Rorippa columbiae*
dwarf evening-primrose	*Camissonia pygmaea*
hepatic monkeyflower	*Mimulus jungermannioides*

The USFWS also classifies "species of concern." These are species that might be in need of conservation actions, however, they receive no legal protection and the use of the term does not necessarily mean that the species will eventually be proposed for listing as a threatened or endangered species. Three fish species, 22 wildlife species, and five plant species occurring in the subbasin fall into the USFWS "species of concern" category (Table 17). The USFS has a similar category of "sensitive species", which are any species for which the Regional Forester has determined that there is a concern for population viability within the state, as evidenced by a significant current or predicted downward trend in populations or habitat. Two fish species and 10 wildlife species in the Umatilla/Willow subbasin are listed as sensitive species by the USFS (Table 18). USFS has also established a list of 30 sensitive plant species found in the Umatilla National Forest; this list was developed by the USFS jointly with other land management agencies and the Heritage Programs of Washington and Oregon, and is based primarily on the rarity of the plant and perceived threats to its well being (Table 19).

Table 17. Fish, wildlife, and plant species of the Umatilla/Willow subbasin that are classified as species of concern by the federal government (USFWS 2002).

Common Name	Scientific Name
Fish:	
margined sculpin	*Cottus marginatus*
Pacific lamprey	*Lampetra tridentate*
redband trout	*Oncorhyncus mykiss*
Birds:	
Black Tern	*Chlidonias niger*
Ferruginous Hawk	*Buteo regalis*
Harlequin Duck	*Histrionicus histrionicus*
Lewis' Woodpecker	*Melanerpes lewis*
Long-billed Curlew	*Numenius americanus*
Mountain Quail	*Oreortyx pictus*
Northern Goshawk	*Accipter gentiles*
Olive-sided Flycatcher	*Contopus borealis*
Tricolored Blackbird	*Agelaius tricolor*
White-headed Woodpecker	*Picoides albolarvatus*
Willow Flycatcher	*Empidonax traillii adastus*
Yellow-breasted Chat	*Icteria virens*
Mammals:	
fringed myotis	*Myotis thysanodes*
long-eared myotis	*Myotis evotis*
long-legged myotis	*Myotis volans*
Preble's shrew	*Sorex preblei*
silver-haired bat	*Lasionycteris noctivagans*
western small-footed myotis	*Myotis ciliolabrum*
wolverine	*Gulo gulo*
Yuma myotis	*Myotis yumanensis*
Amphibians:	
tailed frog	*Ascaphus truei*
Reptiles:	
northern sagebrush lizard	*Sceloporus graciosus graciosus*
Plants:	
Columbia yellow-cress	*Rorippa columbiae*
Douglas clover	*Trifolium douglasii*
hepatic monkeyflower	*Mimulus jungermannioides*
Laurence's milk-vetch	*Astragalus collinuse* var. *laurentii*
long-haired star-tulip	*Calochortus longebarbatus* var. *longebarbatu*s

Table 18. Fish and wildlife species of the Umatilla/Willow subbasin that are listed as sensitive species by the USFS (USFS 2000).

Common Name	Scientific Name
Fish:	
margined sculpin	*Cottus marginatus*
redband trout	*Oncorhyncus mykiss*
Birds:	
American Peregrine Falcon	*Falco peregrinus anatum*
Gray Flycatcher	*Empidonax wrightii*
Harlequin Duck	*Histrionicus histrionicus*
Red-necked Grebe	*Podiceps grisegena*
Tricolored Blackbird	*Agelaius tricolor*
Mammals:	
Townsend's big-eared bat	*Corynorhinus townsendii*
wolverine	*Gulo gulo*
Amphibians:	
Columbia spotted frog	*Rana luteiventris*
northern leopard frog	*Rana pipiens*
Reptiles:	
painted turtle	*Chrysemys picta*

Table 19. Sensitive plant species on the Umatilla National Forest as of July 2002 (Umatilla National Forest 2002).

Common Name	Scientific Name
arrow-leaved thelypody	*Thelypodium eucosmum*
Arthur's milkvetch	*Astragalus arthuri*
Back's sedge	*Carex backii*
Blue Mountain onion	*Allium diction*
branching montia	*Montia diffusa*
clustered lady slipper	*Cypripedium fasciculatum*
crenulate moonwort	*Botrychium crenulatum*
Cusick's milkvetch	*Astragalus cusickii cusickii*
Douglas clover	*Trifolium douglasii*
Farr willow	*Salix farriae*
granite phlox/prickly phlox	*Leptodactylon pungens*
inland sedge	*Carex interior*
lance-leaf grapfern	*Botrychium lanceolatum*
longbearded sego lily	*Calochortus longebarbatus longebarbatus*
Mingan grapefern	*Botrychium minganense*
moonwort grapefern	*Botrychium lunaria*
mountain buttercup	*Ranunculus populago*
mountain grapefern	*Botrychium montanum*
Nez Perce mariposa lily	*Calochortus macrocarpus maculosus*
Oregon bolandra	*Bolandra oregano*
pinnate grapefern	*Botrychium pinnatum*
porcupine sedge	*Carex hystericina*
pussy clover	*Trifolium plumosum plumosum*
Sabin's lupine	*Lupinus sabinianus*
Sierra onion	*Allium campanulatum*
Snake River daisy	*Erigeron disparipilus*
Spalding's silene	*Silene spaldingii*
stalked moonwort	*Botrychium pedunculosum*
two-spiked moonwort	*Botrychium paradoxum*
windowleaf moonwort	*Botrychium fenestratum*

At the state level, Oregon has a multi-tiered classification of sensitive species for fish and wildlife. Oregon classifies "critical sensitive species" as those species whose listing as threatened or endangered status is pending, or for which immediate conservation actions are needed to prevent their listing. In addition to the critical category, Oregon also recognizes sensitive wildlife species that are vulnerable, peripheral or naturally rare, or have an undetermined status. Vulnerable sensitive species are those whose listing as threatened or endangered is not imminent and may be avoided by continued or expanded use of adequate protective measures and monitoring. Peripheral or naturally rare species are sensitive because they are species whose Oregon populations are at the edge of their range, or because they have had historically low population numbers in Oregon because of naturally limiting factors. Species with an undetermined status may also be susceptible to population decline, but need more study to determine their status. The Umatilla/Willow subbasin has three fish species and 43 wildlife species found on Oregon's sensitive species list; this list includes 15 wildlife species that are considered "critical sensitive species" (Table 20).

Table 20. Oregon sensitive fish and wildlife species of the Umatilla/Willow subbasin that fall into one of four categories: critical, vulnerable, peripheral or naturally rare, or of undetermined status (ODFW 1997). See text for an explanation of each category.

Common Name	Scientific Name	Oregon Sensitive Status
Fish:		
margined sculpin	*Cottus marginatus*	Vulnerable
Pacific lamprey	*Lampetra tridentate*	Vulnerable
redband trout	*Oncorhyncus mykiss*	Vulnerable
Amphibians:		
northern leopard frog	*Rana pipiens*	Critical
tailed frog	*Ascaphus truei*	Vulnerable
western toad	*Bufo boreas*	Vulnerable
Columbia spotted frog	*Rana luteiventris*	Undetermined Status
Woodhouse toad	*Bufo woodhousii*	Peripheral or Naturally Rare
Birds:		
Black-backed Woodpecker	*Picoides arcticus*	Critical
Burrowing Owl	*Athene cunicularia*	Critical
Ferruginous Hawk	*Buteo regalis*	Critical
Flammulated Owl	*Otus flammeolus*	Critical
Lewis' Woodpecker	*Melanerpes lewis*	Critical
Northern Goshawk	*Accipiter gentiles*	Critical
Northern Pygmy-owl	*Glaucidium gnoma*	Critical
Sage Sparrow	*Amphispiza belli*	Critical
Three-toed Woodpecker	*Picoides tridactylus*	Critical
White-headed Woodpecker	*Picoides albolarvatus*	Critical
Yellow-billed Cuckoo	*Coccyzus americanus*	Critical
Yellow-breasted Chat	*Icteria virens*	Critical
Grasshopper Sparrow	*Ammodramus savannarum*	Vulnerable
Great Gray Owl	*Strix nebulosa*	Vulnerable
Loggerhead Shrike	*Lanius ludovicianus*	Vulnerable
Long-billed Curlew	*Numenius americanus*	Vulnerable
Olive-sided Flycatcher	*Contopus cooperi*	Vulnerable
Pileated Woodpecker	*Dryocopus pileatus*	Vulnerable
Sandhill Crane	*Grus canadensis*	Vulnerable
Swainson's Hawk	*Buteo swainsoni*	Vulnerable
Bank Swallow	*Riparia riparia*	Undetermined Status
Mountain Quail	*Oreortyx pictus*	Undetermined Status
Williamson's Sapsucker	*Sphyrapicus thyroideus*	Undetermined Status
Willow Flycatcher	*Empidonax traillii*	Undetermined Status
Black-throated Sparrow	*Amphispiza bilineata*	Peripheral or Naturally Rare
Tricolored Blackbird	*Agelaius tricolor*	Peripheral or Naturally Rare
Mammals:		
Townsend's big-eared bat	*Corynorhinus townsendii*	Critical
American marten	*Martes americana*	Vulnerable
fringed myotis	*Myotis thysanodes*	Vulnerable
pallid bat	*Antrozous pallidus*	Vulnerable
long-eared myotis	*Myotis evotis*	Undetermined Status
long-legged myotis	*Myotis volans*	Undetermined Status
silver-haired bat	*Lasionycteris noctivagans*	Undetermined Status
western small-footed myotis	*Myotis ciliolabrum*	Undetermined Status
white-tailed jackrabbit	*Lepus townsendii*	Undetermined Status

Table 20 (continued). Sensitive wildlife species of the Umatilla/Willow subbasin that fall into one of four categories: critical, vulnerable, peripheral or naturally rare, or of undetermined status (ODFW 1997). See text for an explanation of each category.

Common Name	Scientific Name	Oregon Sensitive Status
Reptiles:		
painted turtle	*Chrysemys picta*	Critical
sagebrush lizard	*Sceloporus graciosus*	Vulnerable
longnose leopard lizard	*Gambelia wislizenii*	Undetermined Status

3.2.1.2 Species Recognized as Rare or Significant to the Local Area

Fish:

The only fish species in the Umatilla/Willow subbasin that is notably rare due to its limited distribution is the margined sculpin. This species' distribution is limited to the northern portion of the Blue Mountains, specifically within the Tuccannon, Walla Walla and Umatilla subbasins. As shown in Table 20, the ODFW has listed the margined sculpin as a state sensitive species due to its limited distribution and human impacts on its habitat.

Several species of Pacific salmon are significant to the local area from the perspective of their use by humans. The Pacific salmon species present in the subbasin, Chinook salmon, coho salmon, and steelhead trout, provide opportunities for recreational and consumptive harvest that is important to the local area from both a cultural/social and an economic standpoint. Both coho and Chinook salmon runs were driven to extinction in the Umatilla/Willow subbasin by impacts from agricultural activities, and reintroduction of both species is underway in the subbasin. Runs of both are now adequate to support annual consumptive sport fisheries.

Wildlife:

As discussed in the previous section (Section 3.2.1.1), many wildlife species found in the Umatilla/Willow subbasin are rare, primarily because of negative impacts associated with human activities. However, in addition to these species, there are several other components of the terrestrial wildlife diversity in the Umatilla/Willow subbasin that are locally significant, including the presence of an unusually large maternity colony of Townsend's big-eared bats, significant strongholds of shrub-steppe-associated species, and a relatively large representation of landbirds.

The Umatilla/Willow subbasin is home to a regionally significant maternity colony of Townsend's big-eared bats (personal communication: C. Scheeler, CTUIR, February 2004), which is both a USFS sensitive species (Table 18) and a state critical sensitive species (Table 20). This is the only known maternity colony of Townsend's big-eared bats in the subbasin and may be one of the largest in the state (personal communication: K. Kroner, April 2004). Because this colony is found in a structure located on private property, its continued protection presents a greater challenge than if it was found on public property.

Other wildlife species that are significant to the local area are wildlife species strongly associated with shrub-steppe habitats. Compared with many other subbasins in the

Columbia Basin, the Umatilla/Willow subbasin has a high proportion of shrub-steppe habitat. As such, it serves as a stronghold for many species associated with high quality shrub-steppe habitat, such as Loggerhead Shrikes, Sage Sparrows, Sage Thrashers, Ferruginous Hawks, Black-Throated Sparrows, sagebrush lizards, black-tailed jackrabbits, and Washington ground squirrels.

Landbirds are also significant in the local area because they account for a majority of the vertebrate diversity in the Umatilla/Willow subbasin. Over 200 species of landbirds occur in the subbasin, making up more than 50% of the terrestrial vertebrate species (Appendix A). The distribution and abundance of many of these birds has been affected by habitat conversion, fire suppression, timber management, and resulting changes in the structure and distribution of plant communities (Marcot et al. 1997). Landbirds found in the Umatilla/Willow subbasin that have declined in abundance regionally are shown in Table 21.

Table 21. Landbird species inhabiting the Umatilla/Willow subbasin with declining population trends.

Species	Primary Habitat for Breeding
American Goldfinch[1]	riparian
American Kestrel[1]	coniferous forest, grassland
Barn Swallow[1]	riparian
Belted Kingfisher[1]	riparian
Chipping Sparrow[1]	coniferous forest
Dark-eyed Junco[1]	coniferous forest, riparian
Lewis' Woodpecker[2]	coniferous forest, riparian
Mourning Dove[1]	coniferous forest, riparian
Olive-sided Flycatcher[1,2]	coniferous forest
Orange-crowned Warbler[1]	riparian
Pine Siskin[2]	coniferous forest
Rock Wren[1]	grassland, cliff, rock, talus
Rufous Hummingbird[1]	coniferous forest, riparian
Swainson's Thrush[1]	coniferous forest, riparian
Varied Thrush[1]	coniferous forest
Vaux's Swift[1]	coniferous forest, riparian
Violet-green Swallow[1]	coniferous forest, riparian
Western Meadow Lark[1,2]	grassland
Western Tanager[1]	coniferous forest, riparian
Western Wood-pewee[1]	coniferous forest, riparian
White-crowned Sparrow[1]	riparian
Williamson's Sapsucker[1]	coniferous forest, riparian
Wilson's Warbler[1]	riparian

[1]Species identified as having a significant declining population trend by Andelman and Stock 1994
[2]Species identified as a high concern to management by Saab and Rich 1997

Plants, Fungi, and Invertebrates:
The Umatilla/Willow subbasin is home to many species of rare or otherwise significant plants, fungi, and invertebrates. Because plants, fungi, and invertebrates are generally considered to be less charismatic than fish and wildlife, they have received relatively little study. Because of this, they are often absent or underrepresented in lists of threatened, endangered, sensitive, and managed species. Information on invertebrates is particularly lacking, despite the fact that they are the most abundant and diverse of all animal groups and fulfill vital roles in ecosystem functioning, including pollination, decomposition, and soil conditioning (Wilson 1987). Like plants, invertebrates also form a major component of both aquatic and terrestrial food webs. Although very little is known about the status and distribution of many of the important plant, fungus, and invertebrate species in the Umatilla/Willow subbasin, data from the Oregon Natural Heritage Program (ONHP) do provide some information about species in these groups that are rare or may be facing significant threats in the subbasin. Table 22 lists 32 plant species, two fungus species, and six invertebrate species that are known to exist in the Umatilla/Willow subbasin and have been recognized by the OHNP as rare or of conservation interest. The status of these species is described by their presence on ONHP lists and their Natural Heritage Network Rank, which is based on an international system for ranking rare, threatened and endangered species throughout the world (see the footnotes associated with Table 22 for more detail). Species are ranked at both a global and state level. Some species may be globally abundant, but rare in Oregon (e.g., Back's sedge), while others may be rare both globally and locally (e.g., Laurence's milk-vetch).

More detailed information is known about three of the species that appear in Table 22. Laurence's milk vetch, a federal species of concern (Table 17), is entirely restricted to 14 small (<20 acres) unprotected sites in the lower subbasin (Kagan et al. 2000). These sites occur either on private lands or on highway right-of-ways. Hepatic monkeyflower, another federal species of concern (Table 17) and a candidate for listing in Oregon (Table 16), is found at one site in the lower subbasin, in the Umatilla River Canyon. This species, which occurs on moist vertical cliffs along major rivers, is only known to occur at 19 sites globally (Kagan et al. 2000). The only known population of rosy balsamroot in the subbasin is found in Juniper Canyon (Kagan et al. 2000).

While not classified as rare by the ONHP, mussels are declining in the Umatilla/Willow subbasin and some have been extirpated from the subbasin. Mussels were historically an important food resource for Native Americans throughout the Columbia basin including within the Umatilla/Willow subbasin (Ray 1942, Lyman 1984). In addition to their cultural importance, mussels are important ecologically. They are primary consumers, detritivores and act as nutrient sinks (McMahon and Bogan 2001). In addition, freshwater mussels filter and clarify large amounts of waters and therefore contribute to maintaining water clarity (McMahon and Bogan 2001). Freshwater mussels can also be important food items for fish, mink, otters and raccoon (Dillon 2000).

Table 22. Plant, fungus, and invertebrate species listed in the Oregon Natural Heritage Program database known to occur currently or historically in the Umatilla/Willow subbasin (ONHP 2001). The heritage list on which the species occurs, and its global and state Natural Heritage Network ranking, are shown.

Common Name	Scientific Name	Heritage List[1]	Global Heritage Rank[2]	State Heritage Rank[2]
Vascular Plants:				
aristulate lipocarpha	*Lipocarpha aristulata*	List 2	5	1
Back's sedge	*Carex backii*	List 2	5	1
Columbia milk-vetch	*Astragalus succumbens*	List 4	4	4
Columbia yellow-cress	*Rorippa columbiae*	List 1	3	3
Douglas clover	*Trifolium douglasii*	List 1	3?	1
Douglas' milk-vetch	*Astragalus kentrophyta* var. *douglassii*	List 1-X	X	X
dwarf evening-primrose	*Camissonia pygmaea*	List 1	3	1
flat-leaved Tolmie's onion	*Allium tolmiei* var. *platyphyllum*	List 3	3	3
gray moonwort	*Botrychium minganense*	List 2	4	2
hepatic monkeyflower	*Mimulus jungermannioides*	List 1	2	2
Kruckeberg's holly fern	*Polystichum kruckebergii*	List 4	4	4
Laurence's milk-vetch	*Astragalus collinuse* var. *laurentii*	List 1	1	1
long-haired star-tulip	*Calochortus longebarbatus* var. *longebarbatus*	List 4	3	3
male fern	*Dryopteris filix-mas*	List 4	5	3
many-flowered onion	*Allium pleianthum*	List 3	3	3
meadow sedge	*Carex praticola*	List 2	5?	2
mountain lady's slipper	*Cypripedium montanum*	List 4	4-5	4
pinnate grape-fern	*Botrychium pinnatum*	List 2	5	2-3
retrorse sedge	*Carex retrorsa*	List 2	5	1
Robinson's onion	*Allium robinsonii*	List 2 - ex	3	H
rosy balsamroot	*Balsamorhiza rosea*	List 2	4	H
rush-like skeletonweed	*Lygodesmia juncea*	List 3	4?	?
Sabine's lupine	*Lupinus sabinianus*	List 4	4	4
salt helitrope	*Heliotropium curassavicum*	List 3	5	?
shining cyperus	*Cyperus bipartitus*	List 3	5	?
stalked-pod milk-vetch	*Astragalus sclerocarpus*	List 4	4	4
Torrey's rush	*Juncus torreyi*	List 4	5	3
variable hot-rock penstemon	*Penstemon deustus* var. *variabilis*	List 3	2	?
western moonwort	*Botrychium hesperium*	List 3	3?	1
Mosses:				
No common name	*Aloina bifrons*	List 2	4	1
No common name	*Bryoerythrophyllum columbianum*	List 2	3	2
No common name	*Helodium blandowii*	List 2	4	2
Fungi:				
No common name	*Gamundia leucophylla*	List 3	3?	1
No common name	*Sclerotinia veratri*	List 3	2?	1

Table 22 (continued). Plant, fungus, and invertebrate species listed in the Oregon Natural Heritage Program database known to occur currently or historically in the Umatilla/Willow subbasin (ONHP 2001). The heritage list on which the species occurs, and its global and state Natural Heritage Network ranking, are shown.

Common Name	Scientific Name	Heritage List[1]	Global Heritage Rank[2]	State Heritage Rank[2]
Invertebrates:				
Columbia River tiger beetle	*Cicindela columbica*	List 1-ex	2	H
Columbia springsnail	*Pyrgulopsis* sp. nov	List 1	2	1
eastern meadow fritillary (butterfly)	*Boloria bellona toddi*	List 2	4-5	1
humped coin (snail)	*Polygyrella polygyrella*	List 3	U	H
southern tightcoil (snail)	*Ogaridiscus subrupicola*	List 1	2-3	H
Umatilla megomphix (snail)	*Megomphix lutarius*	List 3	1	H

[1]List 1 contains taxa that are threatened with extirpation or presumed to be extinct throughout their entire range; List 2 contains taxa that are threatened with extirpation or presumed to be extirpated from the state of Oregon.; List 3 contains species for which more information is needed before status can be determined, but which may be threatened or endangered in Oregon or throughout their range; List 4 contains taxa which are of conservation concern but are not currently threatened or endangered. "ex" indicates the species is extirpated from Oregon and "X" indicates the species is thought to be extinct throughout its range.
[2] Rank 1 indicates the species is critically imperiled because of extreme rarity or because it is somehow especially vulnerable to extinction or extirpation, typically with 5 or fewer occurrences; Rank 2 indicates the species is imperiled because of rarity or because other factors demonstrably make it very vulnerable to extinction, typically with 6-20 occurrences; Rank 3 indicates the species is rare, uncommon or threatened, but not immediately imperiled, typically with 21-100 occurrences; Rank 4 indicates the species is not rare and apparently secure, but with cause for long-term concern, usually with more than 100 occurrences; and Rank 5 indicates the species is demonstrably widespread, abundant, and secure. "H" indicates "historical occurrence", i.e., the species was formerly part of the native biota with the implied expectation that it may be rediscovered; "X" means the species is presumed extirpated or extinct; "U" means the rank of the species is unknown; and "?" means the assigned rank is uncertain.

3.2.1.3 Species with Special Ecological Importance to the Subbasin

Fish:

The Pacific salmon species that spawn and rear in the subbasin are very important ecologically. While the impact of increasing salmon numbers on terrestrial wildlife in the subbasin as a result of the reintroduction of coho and Chinook salmon has not been quantified, it is likely substantial. Salmon carcasses, particularly in the lower Umatilla River and the North Fork Umatilla River, are once again abundant. Although the effect of increases in salmon carcasses has not been quantified in the Umatilla/Willow subbasin, a variety of studies in other regions of the Northwest and Alaska support the hypothesis that salmon carcasses play key roles in both aquatic and terrestrial food webs and nutrient cycling. Salmon carcasses provide an important source of marine-derived nutrients to streams and their adjacent riparian zones. Nutrients leached from carcasses stimulate primary productivity in streams (Kline et al. 1993). These nutrients are also directly taken up by macroinvertebrates that feed on the carcasses (Minakawa et al. 2002), and these macroinvertebrates are, in turn, consumed by juvenile salmon (Piorkwoski 1995). In addition, evidence exists that marine-derived nutrients found in salmon carcasses make their way into riparian vegetation from the excretion of these nutrients by scavengers, such as black bears (Bilby et al. 1996). Although the magnitude of the impact of salmon carcasses on nutrient cycling and food webs within the Umatilla/Willow subbasin has not been studied, observations of dramatic increases in the number of black bears gathering at the North Fork of the Umatilla River during spring Chinook spawning over the past five years suggests the importance of carcasses in the subbasin (personal communication: T. Bailey, ODFW, April 2004).

Wildlife:

Several groups of wildlife species have special ecological importance to the Umatilla/Willow subbasin, including: 1) functional specialists, 2) critical functional link species, 3) species with an association with salmonids, 4) Partners in Flight (PIF) species, 5) managed game species, and 6) species identified in the Habitat Evaluation Procedure (HEP) loss assessment. Each group is discussed briefly below.

Functional Specialists: Functional specialists are those wildlife species that perform very few and very specific ecological roles (IBIS 2004). As such, the persistence of these species depends on the continued existence of the required habitat or resource. One example of a functional specialist in the Umatilla/Willow subbasin is the Turkey Vulture, which feeds on carrion and little else. Accordingly, a decrease in the availability of carrion will negatively impact this species. Vertebrate species occurring in the Umatilla/Willow subbasin that have been identified as functional specialists by IBIS are listed in Table 23.

Table 23. Functional specialists occurring in the Umatilla/Willow subbasin (IBIS 2004).

Common Name	**Scientific Name**
Birds:	
Black Swift	*Cypseloides niger*
Common Nighthawk	*Chordeiles minor*
Gyrfalcon	*Falco rusticolus*
Harlequin Duck	*Histrionicus histrionicus*
Merlin	*Falco columbarius*
Northern Pygmy-owl	*Glaucidium gnoma*
Peregrine Falcon	*Falco peregrinus*
Snowy Owl	*Nyctea scandiaca*
Turkey Vulture	*Cathartes aura*
Mammals:	
Canada lynx	*Lynx canadensis*
wolverine	*Gulo gulo*

Critical Functional Link Species: A terrestrial species is characterized as a critical functional link species if it is the only species, or one of just a few species, in a particular wildlife habitat type that performs a particular key ecological function (IBIS 2004). The loss of these species may mean the loss of this function in the wildlife habitat type. Critical functional link species identified by IBIS that occur in the Umatilla/Willow subbasin are listed in Table 24. One example of a critical functional link species in the Umatilla/Willow subbasin is the American beaver, which plays a unique role in every habitat in which it occurs by impounding water as it creates diversions or dams. Several species play multiple unique roles; for example the black bear eats the bark, cambium, and bole of trees, excavates cavities in snags or live trees, and physically fragments standing wood (IBIS 2004).

Table 24. List of critical functional link terrestrial wildlife species in the Umatilla/Willow subbasin (IBIS 2004).

Common Name	Scientific Name
Amphibians:	
Great Basin spadefoot	*Scaphiopus intermontanus*
long-toed salamander	*Ambystoma macrodactylum*
Birds:	
Black-chinned Hummingbird	*Archilochus alexandri*
Brown-headed Cowbird	*Molothrus ater*
Canada Goose	*Branta canadensis*
Double-crested Cormorant	*Phalacrocorax auritus*
Great Blue Heron	*Ardea herodias*
Great Horned Owl	*Bubo virginianus*
Greater Scaup	*Aythya marila*
Redhead	*Aythya americana*
Rufous Hummingbird	*Selasphorus rufus*
Williamson's Sapsucker	*Sphyrapicus thyroideus*
Mammals:	
American beaver	*Castor canadensis*
black bear	*Ursus americanus*
bushy-tailed woodrat	*Neotoma cinerea*
common porcupine	*Erethizon dorsatum*
deer mouse	*Peromyscus maniculatus*
golden-mantled ground squirrel	*Spermophilus lateralis*
mink	*Mustela vison*
mountain lion	*Puma concolor*
northern pocket gopher	*Thomomys talpoides*
mountain cottontail	*Sylvilagus nuttallii*
red squirrel	*Tamiasciurus hudsonicus*
Rocky Mountain elk	*Cervus elaphus nelsoni*
snowshoe hare	*Lepus americanus*

<u>*Species Associated with Salmonids:*</u> The Umatilla/Willow subbasin also has numerous species that are linked, in some manner, to salmonids. The wildlife species of the subbasin that have been identified by IBIS as species that eat salmonid eggs, fry, fingerlings, parr, smolts, adults, or carcasses are listed in Table 25.

Table 25. List of wildlife species in the Umatilla/Willow subbasin that eat different stages of salmonids (IBIS 2004).

Common Name		
Birds:	**Birds:**	**Birds:**
American Crow	Great Egret	Varied Thrush
American Dipper	Greater Scaup	Violet-green Swallow
American Robin	Greater Yellowlegs	Western Grebe
American White Pelican	Green Heron	Willow Flycatcher
Bald Eagle	Green-Winged teal	Winter Wren
Bank Swallow	Harlequin Duck	**Mammals:**
Barn Swallow	Herring Gull	American marten
Barrow's Goldeneye	Hooded Merganser	black bear
Belted Kingfisher	Horned Grebe	bobcat
Black-billed Magpie	Killdeer	coyote
Black-crowned Night-heron	Mallard	deer mouse
California Gull	Northern Rough-winged Swallow	long-tailed weasel
Canvasback	Osprey	mink
Caspian Tern	Peregrine Falcon	mountain lion
Clark's Grebe	Pied-billed Grebe	northern flying squirrel
Cliff Swallow	Red-breasted Merganser	northern raccoon
Common Goldeneye	Red-necked Grebe	northern river otter
Common Loon	Red-tailed Hawk	red fox
Common Merganser	Ring-billed Gull	striped skunk
Common Raven	Snowy Owl	vagrant shrew
Common Tern	Song Sparrow	Virginia opossum
Double-crested Cormorant	Spotted Sandpiper	water shrew
Forster's Tern	Spotted Towhee	white-tailed deer
Golden Eagle	Tree Swallow	**Reptiles:**
Gray Jay	Trumpeter Swan	common garter snake
Great Blue Heron	Turkey Vulture	

PIF Species: Other species with special ecological importance to the subbasin are Partner in Flight species. Partners in Flight (PIF) is "a cooperative effort involving partnerships among federal, state and local government agencies, philanthropic foundations, professional organizations, conservation groups, industry, the academic community, and private individuals" (PIF 2002). Founded in 1990, the original purpose of PIF was to aid neotropical migratory birds that breed in the Nearctic and winter in the Neotropics. However, the organization now works to conserve most landbirds. PIF produces both national and state lists of species they believe should be considered in land use plans, project planning, impact assessments, research, monitoring, outreach and other activities. A total of 74 species found in the Umatilla/Willow subbasin are on the Oregon PIF list (Table 26).

Table 26. Common names of the 74 birds species found in the Umatilla/Willow subbasin that are on the Oregon PIF list (IBIS 2004).

Common Name		
American Dipper	Gray Flycatcher	Swainson's Hawk
American Kestrel	Great Gray Owl	Swainson's Thrush
American Pipit	Green-tailed Towhee	Townsend's Solitaire
Ash-throated Flycatcher	Hammond's Flycatcher	Townsend's Warbler
Bank Swallow	Hermit Thrush	Varied Thrush
Black Swift	Horned Lark	Vaux's Swift
Black-backed Woodpecker	House Wren	Veery
Black-headed Grosbeak	Lark Sparrow	Vesper Sparrow
Black-throated Gray Warbler	Lewis' Woodpecker	Warbling Vireo
Black-throated Sparrow	Lincoln's Sparrow	Western Bluebird
Brewer's Sparrow	Loggerhead Shrike	Western Meadowlark
Brown Creeper	MacGillivray's Warbler	Western Tanager
Bullock's Oriole	Nashville Warbler	Western Wood-pewee
Burrowing Owl	Northern Harrier	White-breasted Nuthatch
Bushtit	Olive-sided Flycatcher	White-headed Woodpecker
Calliope Hummingbird	Orange-crowned Warbler	White-throated Swift
Chipping Sparrow	Pileated Woodpecker	Williamson's Sapsucker
Clark's Nutcracker	Purple Finch	Willow Flycatcher
Common Poorwill	Red Crossbill	Wilson's Warbler
Downy Woodpecker	Red-eyed Vireo	Winter Wren
Dusky Flycatcher	Red-naped Sapsucker	Yellow Warbler
Ferruginous Hawk	Rufous Hummingbird	Yellow-billed Cuckoo
Flammulated Owl	Sage Sparrow	Yellow-breasted Chat
Fox Sparrow	Sage Thrasher	Yellow-rumped Warbler
Grasshopper Sparrow	Short-eared Owl	

Managed Game Species: The Umatilla/Willow subbasin is also home to many game species. A total of 53 species in the subbasin are classified as managed game species or fur-bearing animals in Oregon (IBIS 2004; personal communication: D. Brunings, ODFW, May 2004; Table 27). In addition to the species listed in Table 27, other hunted or trapped species in the subbasin include coyote, American badger, striped and Western spotted skunk, Virginia opossum, long-tailed weasel, and ermine. Several ODFW management plans provide guidance for managing these species in the subbasin,

Table 27. Managed game species and fur-bearing animals in the Umatilla/Willow subbasin.

Common Name	Scientific Name
Amphibians:	
bullfrog	*Rana catesbeiana*
Birds:	
American Coot	*Fulica americana*
American Crow	*Corvus brachyrhynchos*
American Widgeon	*Anas americana*
Barrow's Goldeneye	*Bucephala islandica*
Blue Grouse	*Dendragapus obscurus*
Blue-winged Teal	*Anas discors*
Bufflehead	*Bucephala albeola*
California Quail	*Callipepla californica*
Canada Goose	*Branta canadensis*
Canvasback	*Aythya valisineria*
Chukar	*Alectoris chukar*
Cinnamon Teal	*Anas cyanoptera*
Common Goldeneye	*Bucephala clangula*
Common Merganser	*Mergus merganser*
Eurasian Widgeon	*Anas penelope*
Gadwall	*Anas strepera*
Gray Partridge	*Perdix perdix*
Greater Scaup	*Aythya marila*
Greater White-fronted Goose	*Anser albifrons*
Green-winged Teal	*Anas crecca*
Harlequin Duck	*Histrionicus histrionicus*
Hooded Merganser	*Lophodytes cucullatus*
Lesser Scaup	*Aythya affinis*
Mallard	*Anas platyrhynchos*
Mountain Quail	*Oreortyx pictus*
Mourning Dove	*Zenaida macroura*
Northern Pintail	*Anas acuta*
Northern Shoveler	*Anas clypeata*
Redhead	*Aythya americana*
Ring-necked Duck	*Aythya collaris*
Ring-necked Pheasant	*Phasianus colchicus*
Ross' Goose	*Chen rossii*
Ruddy Duck	*Oxyura jamaicensis*
Ruffed Grouse	*Bonasa umbellus*
Snow Goose	*Chen caerulescens*
White-winged Scoter	*Melanitta fusca*
Wild Turkey	*Meleagris gallopavo*
Wood Duck	*Aix sponsa*
Mammals:	
American beaver	*Castor canadensis*
American marten	*Martes americana*
black bear	*Ursus americanus*
bobcat	*Lynx rufus*
mink	*Mustela vison*
mountain lion	*Puma concolor*
mule deer	*Odocoileus hemionus*
muskrat	*Ondatra zibethicus*

Table 27 (continued). Managed game species and fur-bearing animals in the Umatilla/Willow subbasin.

Common Name	Scientific Name
Mammals (continued):	
northern raccoon	*Procyon lotor*
northern river otter	*Lutra canadensis*
pronghorn	*Antilocapra americana*
red fox	*Vulpes vulpes*
Rocky Mountain elk	*Cervus elaphus nelsoni*
white-tailed deer	*Odocoileus virginianus*

including *Oregon's Elk Management Plan*, *Oregon's Mule Deer Management Plan*, *Oregon's Black Bear Management Plan*, *Oregon's Cougar Management Plan*, *Oregon's Western Canada Mallard Management Plan*, and *Oregon's Taverner/Lesser Canada Goose Management Plan*.

HEP Species: Certain species in the Columbia River basin were selected during the USFWS Habitat Evaluation Procedure (HEP) loss assessment process, and used to model impacts from adjacent hydro-development. HEP species relevant to the Umatilla/Willow subbasin are those selected for the John Day and McNary dams (Table 28).

Table 28. HEP species selected for the John Day and McNary dams (IBIS 2004).

Common Name	Scientific Name
Birds:	
Spotted Sandpiper	*Actitis macularia*
Mallard	*Anas platyrhynchos*
Great Blue Heron	*Ardea herodia*
Lesser Scaup	*Aytha affinis*
Canada Goose	*Branta canadensis*
Blue Grouse	*Dendragapus obscurus*
Yellow Warbler	*Dendraica petechia*
California Quail	*Lophortyx californicus*
Black-capped Chickadee	*Parus atricopillus*
Downy Woodpecker	*Picoides pubescens*
Western Meadowlark	*Sturnella neglecta*
Mammals:	
mink	*Mustela vison*
mule deer	*Odocoileus hemionus*

3.2.1.4 Species Recognized by Columbia Plateau Tribes as Having Cultural or Religious Value

All living things are valued by the Tribes of the Columbia Plateau. In general, tribal religious beliefs are that the Creator created and gave foods and medicines in the form of plants and animals to the Natityat (i.e., Indian people) to survive. In return the Natityat made a promise to the Creator to always protect these gifts. As such, each species is believed to fulfill important roles in the ecosystem. Some examples of these roles in tribal tradition and culture are shown in Table 29.

Table 29. Some examples of the importance of plants and animals in the cultural and spiritual lives of the Natityat.

Traditional or Cultural Role	Examples of Animals Involved
regalia	eagle feathers and otter, deer, and elk pelts
instruments/drums	eagle whistle, deer hide drum, dew claw rattles
housing	tule, lodgepole
subsistence	salmon, whitefish, mule deer, elk, grouse, chokecherry, lamprey, fresh water mussel, huckleberry, various root food plants, mushrooms
medicinal	various plants
burial/religious ceremonies	tule
stories/oral histories	coyote, owl
tools	elk/deer antler tools, fish bones, willow, mock orange, oceanspray, dogbane hemp

3.2.1.5 Locally Extirpated and Introduced Species

Fish:

Currently more than 31 species of fish inhabit the Umatilla River and its tributaries. Eleven species are introduced exotics, 17 are native to the subbasin, and three are reintroduced endemic species (Table 34). The species composition and distribution of fish in the Willow Creek subbasin are not well known. However, it is assumed that fish species in the Willow Creek subbasin are generally the same as those found in the Umatilla subbasin, with the exception of anadromous salmon and steelhead. Sixteen Mile Canyon, Sand Hollow and Juniper Canyon are known to be intermittent streams in many locations; however extensive surveys have not been conducted and there may be some perennial reaches that support fish.

The Umatilla/Willow subbasin historically supported large populations of spring and fall Chinook and coho salmon. These populations were extirpated from the subbasin in the early 20th century (Boyce 1986). Extirpation of these populations occurred primarily as a result of habitat degradation, compromised fish passage resulting from diversion dams, and prolonged irrigation water withdrawals (Boyce 1986, Phillips et al. 2000). Hatchery reared coho salmon were introduced into the subbasin from 1966 to 1969 and then from 1987 until the present. Hatchery reared fall Chinook were introduced into the subbasin in 1982, and spring Chinook in 1986. More information on the release of hatchery reared salmon into the subbasin is given in Section 3.2.3.3.

Historically, non-endemic rainbow trout were stocked throughout the Umatilla and Willow Creek subbasins to augment sport fisheries. This widespread stocking occurred from the 1940s through the 1970s and has been gradually reduced due to reduced funding and conservation concerns. See Section 3.2.3.3 for more details about the history of rainbow trout stocking in the subbasin.

One introduction of an exotic fish species in the Umatilla subbasin was accidental. Mosquito fish, which were introduced into standing waters of the subbasin to reduce mosquito abundance for public health issues, inadvertently spread into the Umatilla River. All other exotic species found in the subbasin have generally been intentionally introduced for the purposes of creating sport fisheries. These introductions have been made either by ODFW or illegally by the public. These species have been primarily introduced into standing water bodies, including McKay and Willow Creek reservoirs, and have dispersed volitionally into streams in the subbasin, primarily downstream of these reservoirs. Introductions into McKay Reservoir include largemouth bass, smallmouth bass, black crappie, white crappie, bluegill, pumpkinseed sunfish, yellow perch, brown bullhead, and channel catfish. These introductions occurred prior to 1970 and the reservoir is currently managed to optimize warmwater fisheries. Introductions into Willow Creek Reservoir have been done so illegally by the public after the reservoir was constructed in 1981. The most significant dispersal of these species is that of

Table 30. Fish species present in the Umatilla subbasin.

Species	**Origin**[1]	**Location**[2]	**Status**[3]	**Comments**
bull trout (*Salvelinus confluentus*)	N	R, T	C	
spring Chinook (*Oncorhynchus tshawytscha*)	H	R, T	C	
fall Chinook (*Oncorhynchus tshawytscha*)	H	R, T	C	
coho salmon (*Oncorhynchus kisutch*)	H	R, T	C	
redband trout/summer steelhead (*Oncorhynchus mykiss*)	N/E	R, T	A	exotic hatchery trout introduced for fisheries
mountain whitefish (*Prosopium williamsoni*)	N	R, T	U	
Pacific lamprey (*Lampetra tridentata*)	N	R, T	U	
western brook lamprey (*Lampetra richardsoni*)	N	R, T	U	
longnose dace (*Rhinichthys cataractae*)	N	R, T	I	
speckled dace (*Rhinichthys osculus*)	N	R, T	A	
Umatilla dace (*Rhinichthys umatilla*)	N	R, T	I	
leopard dace (*Rhinichthys falcatus*)	N	R, T	I	
chiselmouth (*Acrocheilus alutaceus*)	N	R, T	C	
peamouth (*Mylocheilus caurinus*)	N	R, T	U	
redside shiner (*Richardsonius balteatus*)	N	R, T	A	
northern pikeminnow (*Ptychocheilus oregonensis*)	N	R, T	C	
sucker (Catostomidae)	N	R, T	C	Bridgelip, largescale
carp (*Cyprinus carpio*)	E	R, T	U	
pumpkinseed (*Lepomis gibbosus*)	E	R, T	R	
bluegill (*Lepomis macrochirus*)	E	R, T	R	
white crappie (*Pomoxis annularis*)	E	R, T	R	
black crappie (*Pomoxis nigromaculatus*)	E	R, T	R	
yellow perch (*Perca flavescens*)	E	R, T	R	
large mouth bass (*Micropterus salmoides*)	E	R	U	
small mouth bass (*Micropterus dolomieu*)	E	R	C	
brown bullhead (*Ameiurus nebulosus*)	E	R	U	
channel catfish (*Ictalurus punctatus*)	E	R	U	
mosquitofish (*Gambusia*)	E	R	U	Seasonal
Paiute sculpin (*Cottus beldingi*)	N	R, T	C	
margined sculpin (*Cottus marginatus*)	N	R, T	C	
torrent sculpin (*Cottus rhotheus*)	N	R, T	R	

[1] Origin: N=native stock, E=exotic, H=hatchery reintroduction with a naturalized sub-population
[2] Location: R= mainstem rivers T= tributaries
[3] Fish species abundance based on average number of fish per $100m^2$: A=abundant, R=rare, U=uncommon, C=common, and I=insufficient data

smallmouth bass into the lower Umatilla River. Although sampling has not been conducted to determine abundance, reports from anglers indicate that significant numbers of smallmouth bass now exist in the lower Umatilla River.

Wildlife:
A number of terrestrial wildlife species have been extirpated from the Umatilla/Willow subbasin, including the Columbia Sharp-tailed Grouse, the Sage Grouse, the gray wolf, the grizzly bear, and the Rocky Mountain bighorn sheep. Columbia sharp-tailed Grouse were extirpated from Oregon in the 1960s due to a combination of factors, including over-hunting in the mid- to late 19th century, the conversion of native habitats to crop production, and habitat degradation from livestock grazing (Hays et al. 1998, Crawford and Coggins 2000). Sage Grouse, a species dependent on shrub-steppe habitat, were extirpated from the Umatilla/Willow subbasin by 1955 because of habitat conversion, overgrazing, and over-hunting (Stinson et al. 2003). The gray wolf and grizzly bear were both extirpated from the subbasin by the 1940s, primarily due to predator control efforts. Rocky Mountain bighorn sheep were extirpated from Oregon in the 1940s due to over-hunting, unregulated domestic livestock grazing, and parasites and diseases carried by domestic livestock (ODFW 2003b).

A large number of terrestrial wildlife species have been introduced to the Umatilla/Willow subbasin, both intentionally and accidentally. Exotic gamebirds introduced into the subbasin to provide recreational activities include the Red Leg Partridge, Ring-necked Pheasant, Wild Turkey, California Quail, Chukar, and Hungarian Partridge. Because these species are popular game species in the Umatilla/Willow subbasin, wildlife managers in the subbasin work to maintain their populations. However, populations of many of these species have been declining in the last 20-30 years for a variety of reasons, including changes in agricultural practices, exotic weed invasions, and weather variability (ODFW 1999).

Other species intentionally introduced as game animals in the Umatilla/Willow subbasin include the bullfrog, the Virginia opossum, the eastern fox squirrel, and the European red fox. Bullfrogs are particularly problematic in the area due to their negative effects on native amphibian species; their introduction is considered a major factor in the decline of many of these species (Csuti et al. 1997). As a result of their aggressive behavior and rapid growth rate, bullfrogs out-compete native amphibians (Corkran and Thoms 1996; personal communications: C. Corkran, February 2001; M. Hayes, WDFW, February 2001). In addition, they are voracious predators, often eating the eggs, tadpoles, and adults of native frog species. In the Umatilla/Willow subbasin, the bullfrog's preferred habitat is similar to that of many other amphibians native to the Umatilla/Willow subbasin, especially to that of the Columbia spotted frog (personal communications: C. Corkran, February 2001; M. Hayes, WDFW, February 2001). The Virginia opossum can also negatively impact native wildlife. As opportunistic feeders, they often consume a variety of small birds, mammals, and reptiles (Csuti et al. 1997). Opossum predation on bird eggs may be limiting native bird populations and is a concern for wildlife managers in the subbasin. The eastern red fox may also exert negative effects on indigenous wildlife species, such as the red tree squirrel, through competition (personal communication: M. Kirsch, ODFW, April 2004).

Two exotic bird species common in the Umatilla/Willow subbasin and virtually everywhere else in the United States are the European Starling and the House Sparrow. Intentionally introduced in the 1800s from Europe, these birds are aggressive competitors for nesting cavities. They commonly out-compete native cavity-nesting birds, and are known to destroy nests and eggs and kill nestlings and adults while taking over nest sites.

Two exotic mammalian species closely associated with humans globally also occur in the Umatilla/Willow subbasin. The Norway rat and house mouse are found in cities and towns of the subbasin, but their prevalence and their effect on native wildlife in the subbasin are not known.

Other exotic animals common in the Umatilla/Willow subbasin are pet animals that escape or are intentionally released. Common feral animals in the subbasin include cats, dogs, and red eared slider turtles. Cats, in particular, are known to have large, negative impacts on terrestrial wildlife, such as birds, rodents, and lizards, an effect that can be magnified in fragmented landscapes (Crooks and Soulé 1999).

Plants and Invertebrates:

The presence of exotic invasive plants is a major problem in the subbasin, and the magnitude of the effect and the most damaging species are described in Section 3.1.1.9. Unfortunately, little is known about the number of plant species that have been extirpated from the Umatilla/Willow subbasin because of a lack of study. However, two plants known to have historically occurred in the Umatilla/Willow subbasin, Douglas' milk-vetch and Robinson's onion, are extirpated from Oregon (OHNP 2001).

Several exotic invertebrate species are also known to occur in the Umatilla/Willow subbasin and are suspected to have negatively affected the native fauna in the area. An example of one common exotic invertebrate in the subbasin is the European earwig, which was found at 90% of 20 riparian sites sampled in the Patawa/Tutuilla watershed in the Umatilla subbasin (Wooster and DeBano 2003). Although the effect of invasive exotic invertebrate species like the European earwig has not been quantified in the subbasin, these species undoubtedly compete with native invertebrate species for a variety of resources. The European honeybee is also common in the Umatilla/Willow subbasin, and is an example of an exotic species that was intentionally introduced by humans to the detriment of native invertebrate pollinators (Kearns et al. 1998). However, European honeybees are highly valued by humans because of two important services they provide: honey production and crop pollination. The annual value of pollination for crop systems in the Unites States, provided primarily by honeybees, is estimated to be between $20-40 billion (Kearns et al. 1998). Other introduced invertebrates that provide beneficial services to humans in the subbasin are a variety of exotic insect species that are used in attempts to control exotic weeds. For example, several species of snout beetles (*Larinus curtus*, *Eustenopus villosus,* and *Bangasternus orientalis*) are used by the BIA to help control yellow starthistle in the subbasin.

Very little is known about how many invertebrate species have been extirpated from the Umatilla/Willow subbasin; only one terrestrial and one aquatic taxon are known or suspected to be extinct. The terrestrial species is the Columbia River tiger beetle, which occurred historically in the subbasin and is now extirpated from Oregon (ONHP 2001). The aquatic taxon is a genus of mussels, *Margaritifera*, which occurred historically in the Umatilla River but was not found in a recent survey of mussels by the CTUIR and is suspected to be locally extinct (personal communication J. Brim Box, CTUIR, April 2004).

3.2.2 Focal Species Selection

3.2.2.1 List of Species Selected

Aquatic:

The following aquatic species were chosen as focal species for the Umatilla/Willow subbasin: summer steelhead/redband trout (*Oncorhyncus mykiss*), coho salmon (*Oncorhyncus kisutch*), spring and fall Chinook salmon (*Oncorhyncus tshawytscha*), and bull trout (*Salvelinus confluentus*). In addition, two other taxa were identified as "taxa of interest;" these are Pacific lamprey (*Lampetra tridentata*) and mussels. Models have not been developed to examine the population dynamics of these taxa under current conditions or under different scenarios of future conditions (i.e., the Ecosystem Diagnosis Treatment Model (EDT) and the Qualitative Habitat Assessment Model (QHA) will not work for the life-histories of lampreys and mussels). However, these taxa are of cultural and ecological interest in the subbasin and are therefore given consideration in this plan.

This list of aquatic focal species was presented to the public and stakeholders on August 6, 2003 in Pendleton, Oregon and the list was finalized on that date.

Terrestrial Wildlife:

Terrestrial wildlife focal species and their associated habitats for the Umatilla/Willow subbasin are listed in Table 31. The rationale for their selection is provided in Section 3.2.2.2. This list of proposed focal species was presented to stakeholders and the public for final consideration and was approved on November 12, 2003.

3.2.2.2 Methodology for Selection

Aquatic:

Aquatic focal species were selected based on three criteria: 1) the degree to which they have special ecological, cultural or legal status, 2) the extent to which they "represent" certain habitat types and the aquatic communities found in those habitats and 3) the availability of adequate knowledge of the species' biology in the subbasin for use in EDT and QHA. While assessment of all fish species present within the Umatilla/Willow subbasin would best insure the needs of each species for habitat protection and restoration, this kind of endeavor is not feasible at this time. Because time and resources for completing this planning process are limited, and because data regarding the biology, distribution, abundance and productivity of all fish species in the subbasin are not

Table 31. Terrestrial focal species selected for the Umatilla/Willow subbasin.

Common Name ***(Scientific Name)***	**Focal Habitat**	**Status[1]**		**Critically Linked**	**Functional Specialist**	**Salmon Associated**	**HEP**	**PIF**	**Managed Game Species**
		Federal	OR						
Pileated Woodpecker *(Dryocopus pileatus)*	montane & eastside mixed conifer forest	n/a	SS-V	No	No	No	No	Yes	No
White-headed Woodpecker *(Picoides albolarvatus)*	ponderosa pine	SC	SS-C	No	No	No	No	Yes	No
Red-naped Sapsucker *(Sphyrapicus nuchalis)*	aspen forest	n/a	n/a	No	No	No	No	Yes	No
Ferruginous Hawk *(Buteo regalis)*	western juniper woodlands	SC	SS-C	No	No	No	No	Yes	No
Grasshopper Sparrow *(Ammodramus savannarum)*	eastside interior grasslands	n/a	SS-V/PNR	No	No	No	No	Yes	No
Sage Sparrow *(Amphispiza nevadensis)*	shrub-steppe	n/a	SS-C	No	No	No	No	Yes	No
Columbia spotted frog *(Rana luteiventris)*	herbaceous wetlands	C, FS	SS-U	No	No	No	No	No	No
Yellow Warbler *(Dendroica petechia)*	eastside interior riparian-wetlands	n/a	n/a	No	No	No	Yes	Yes	No
American beaver *(Castor canadensis)*		n/a	n/a	No	No	No	No	No	Yes
Great Blue Heron *(Ardea herodias)*		n/a	n/a	Yes	No	Yes	Yes	No	No

[1] Status: C=candidate species; SC=species of concern; FS- Forest Service sensitive species; SS-C=sensitive species-critical; SS-V=sensitive species-vulnerable; SS-V/PNR=sensitive species-vulnerable/peripheral or naturally rare; SS-U=sensitive species-undetermined

available, an approach that selects key indicator species to represent all species and habitats in the ecosystem is prudent and necessary.

For the first criterion, consideration was first given to species that specifically require assessment due to ecological, cultural or legal importance. Species listed under the federal ESA were adopted as focal species. Consideration was also given to species that are of significant interest to the cultures represented in the subbasin, both Native American and non-Native American. Finally, consideration was given as to whether or not there are species in the subbasin that require assessment with regard to their critical role in the ecology of the ecosystem.

For the second criterion, an emphasis was placed on those species and associated habitats that are the focus of restoration actions under the Columbia Basin Fish & Wildlife Program. In addition, aquatic species were considered based on their habitat use (both spatially and temporally) relative to the habitat conditions that exist throughout the subbasin. Special consideration was given to species that have the most stringent habitat requirements; focusing development of restoration plans around these key species will ensure that habitat requirements of all species of management concern will be addressed to the extent possible.

Bull trout were first selected as a focal species based on their threatened status under the federal ESA. However, the ecological merits for selecting this species are strong as well. Bull trout have the most stringent habitat requirements of any fish species inhabiting the Umatilla subbasin. They require cold water of the highest quality and stable, complex habitat. Their distribution in the subbasin is limited, but encompasses areas not occupied significantly by other species. Bull trout serve as good indicators of high quality habitat and of degradation where distribution has decreased.

Like bull trout, summer steelhead were first selected as a focal species because of their threatened status under the federal ESA as a population of the Middle Columbia River ESU. While the anadromous from of steelhead is listed, the resident form (redband trout) is not. However, as the knowledge base on this species grows, so does our understanding of the interaction of the anadromous and resident life history forms. Because it cannot be assumed that the resident and anadromous forms are reproductively isolated, we chose to consider both forms as the focal species. In addition to their legal status, summer steelhead inhabit a large portion of the subbasin, more than the other salmonid species, yet require cold and clean water and high quality instream habitat. For rearing, in particular, steelhead require higher quality freshwater habitat than do the other anadromous species. Finally, the life history of steelhead is unique in that they have a relatively long freshwater residency of one to four years as juveniles.

Spring Chinook were selected as a focal species because their habitat requirements and life history characteristics are intermediate between summer steelhead and bull trout, and thus more strongly represent habitat that is transitional in quality. In addition, spring Chinook have some unique life history requirements. Adults immigrate into the subbasin from April through July as flows decrease and water temperatures increase. This exposes adults during the later part of the return to high risks of pre-spawning mortality. Adults then hold for approximately two months (June and July) in the upper Umatilla River prior to spawning, which requires high quality summertime holding habitat.

Coho were selected because their spawning and rearing distribution is mainly in the mainstem of the Umatilla River downstream of Pendleton, an area not used significantly for spawning or rearing by summer steelhead or spring Chinook.

Fall Chinook were selected as a focal species based primarily on their cultural, social, and political importance in the subbasin. Not only are fall Chinook culturally significant to the Tribes in the subbasin, but they are also socially and politically important because a large investment of public resources has been made in an on-going fall chinook reintroduction effort in the Umatilla subbasin through artificial production. Because the investment in the artificial program is expected to continue and program goals include natural production in the subbasin, managers believe it is important to complete a detailed habitat assessment through EDT for fall Chinook. An EDT analysis is needed to aid future management decisions including a possible reexamination of fall Chinook production goals for the subbasin.

All aquatic focal species selected have sufficient data for modeling using EDT or QHA. However, it was felt that limiting the aquatic species chosen to those suitable for use in EDT and QHA was too restrictive and eliminated species that have cultural and ecological importance in the subbasin, but for which detailed biological data are limited. Therefore, a category called “taxa of interest” was developed that allowed the inclusion of important aquatic species that, while their status cannot be assessed using the modeling approaches, hold great interest in the subbasin in terms of developing management strategies.

Lamprey and mussels were selected as “taxa of interest” as a result of both their cultural and ecological importance. Historically, Pacific lamprey were used both as food and for medicinal purposes by Native Americans throughout the Columbia basin (Close et al. 2002). Lamprey numbers have declined dramatically in the subbasin over the past century and there is no longer a tribal harvest of these animals. Pacific lamprey are currently the focus of a restoration initiative by the CTUIR (Close 1999).

Two genera of mussels are found in the lower Umatilla subbasin, *Anodonta* and *Gonidea*, and a third, *Margaritifera*, was found historically in the subbasin, but now appears to be locally extinct (personal communication: J. Brim Box, CTUIR, April 2004). Mussels were historically an important food resource for Native Americans throughout the Columbia basin including within the Umatilla/Willow subbasin (Ray 1942, Lyman 1984). Native American use of freshwater mussels decreased during the last 200 years, probably due to declines in native populations and assimilation following Euro-American settlement (Chatters 1995). A Umatilla tribal elder, however, remembered his parents trading fish for dried mussels as late as the 1930s (personal communication: E. Quaempts, CTUIR tribal member, 1996). In addition to their cultural importance, mussels are important ecologically; they are important detritivores and act as nutrient sinks (McMahon and Bogan 2001). In addition, freshwater mussels filter and clarify large amounts of water and therefore contribute to maintaining water clarity (McMahon and Bogan 2001). Freshwater mussels are also important food items for fish, mink, otters and raccoon (Dillon 2000).

Terrestrial[1]:

In contrast to the selection of aquatic focal species, terrestrial focal species for the Umatilla/Willow subbasin were selected using a more holistic approach that emphasizes ecosystem management through the use of focal habitat types while including components of single-species, guild, or indicator species assemblages. This approach is more appropriate for terrestrial systems than aquatic ones, and is based on the assumption that conservation strategies for terrestrial systems that emphasize focal habitats are more desirable than those that emphasize individual species.

By combining the "coarse filter" (focal habitats) with the "fine filter" (focal wildlife species assemblage) approach, subbasin planners believe there is a much greater likelihood of maintaining, protecting and/or enhancing key focal habitat attributes and providing functioning ecosystems for terrestrial wildlife. This approach not only identifies priority focal habitats, but also describes the most important habitat conditions and attributes needed to sustain obligate wildlife populations within these focal habitats. Conservation and management directed towards focal species will establish conditions that will also benefit a wider group of species with similar habitat requirements.

The rationale for using focal species is to draw immediate attention to habitat features and conditions most in need of conservation or most important in a properly functioning ecosystem. These focal species can serve as "poster" species for a given habitat type, helping stakeholders and the public to better relate to the somewhat abstract notion that habitats are often the primary target of management actions, not species.

Umatilla/Willow subbasin planners selected ten focal species (Table 31) from a list of focal candidates that met one or more of the categories indicating ecological importance, as presented in Section 3.2.1. Planners selected species that had life requirements representative of habitat conditions or features that are important within the properly functioning focal habitat types identified in the IBIS database. These habitat types are described in Section 3.2.4.2, and relationship of the focal species and the focal habitat type are described in Section 3.4.2. Planners also looked for species to provide a focus for describing desired habitat conditions, attributes, and needed management strategies and/or actions. While consideration was given to the value of using focal species for monitoring and evaluation of management strategies, this was not an obligatory

[1] Large portions of the text in this section originate from a 2004 draft of the *Southeast Washington Subbasin Planning Ecoregion Wildlife Assessment*, and are used with permission to C. Scheeler from the authors, P. Ashley and S. Stovall. The text has been slightly modified to fit into the context of the Umatilla/Willow subbasin.

consideration, as monitoring and evaluation is likely to be tiered to a more regionally consistent strategy.

It is important to note that non-focal species, including managed species and federal and state listed species for which species specific management and recovery plans have been developed, may also dictate habitat management considerations in ways that do not conform to the habitat/focal species framework. Therefore, as needed, management and habitat requirements of non-focal species will be included in the assessment and management plan and referenced by appended management plans for those species.

3.2.3 Aquatic Focal Species and Taxa of Interest: Population Delineation and Characterization

3.2.3.1 Focal Species Population Data, Life History, and Distribution

Bull Trout

Abundance and Population Trends
In 1998 bull trout in the Columbia River basin were listed as threatened by the USFWS (2002). In the Umatilla/Willow subbasin they occur in only a limited area in the upper Umatilla River, the North and South Forks, and in North Fork Meacham Creek (Figure 32). The USFWS Draft Bull Trout Recovery Plan (DBTRP) establishes recovery criteria of 500 to 1000 spawning adults per population. The information presented below suggests that the bull trout populations in the Umatilla subbasin are well below the level necessary for recovery under the DBTRP. The DBTRP identifies two local populations in the Umatilla core area: the upper Umatilla population and the Meacham Creek population (Figure 32).

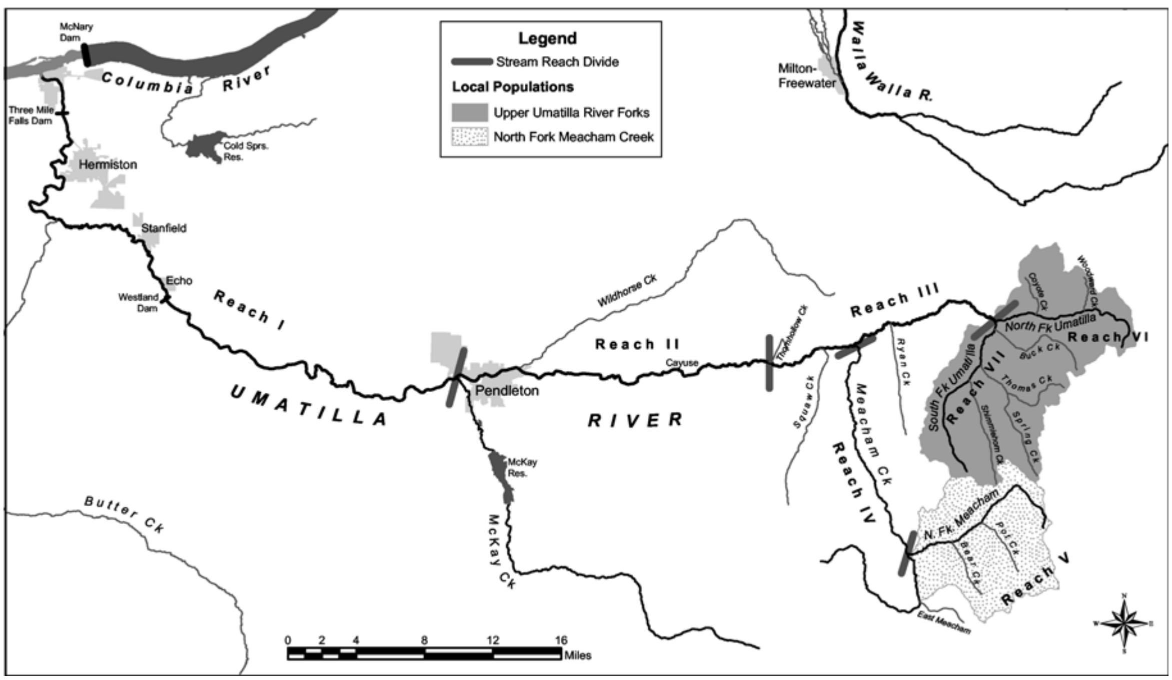


Figure 32. Locations of the two local bull trout populations in the Umatilla/Willow subbasin. Figure provided by John Stephenson, USFWS, April, 2004.

Spawner abundance has been tracked since 1994 in the North and South Forks of the Umatilla and North Fork of Meacham Creek through redd counts (Figure 33). While redd counts are best used as indicators of trends in abundance, they are the only long term data set currently available to gain an understanding of bull trout abundance in the Umatilla subbasin. Between 1994 and 1999 the number of redds counted within the North Fork Umatilla Index Reach (from the confluence of Coyote Creek to the confluence of Woodward Creek) increased substantially from 29 to 144, respectively (Figure 33). However, the number of redds counted declined substantially from 1999 to 2003 with the lowest count of this period being 48 redds in 2002. While it is understood that redd data is best interpreted at the scale of decades, the pattern in redd abundance over the past decade is probably of great enough magnitude to be real rather than an artifact of sampling bias or variability. Even with the decline in redd number over the past four years, the trend over the past decade is positive (Figure 33).

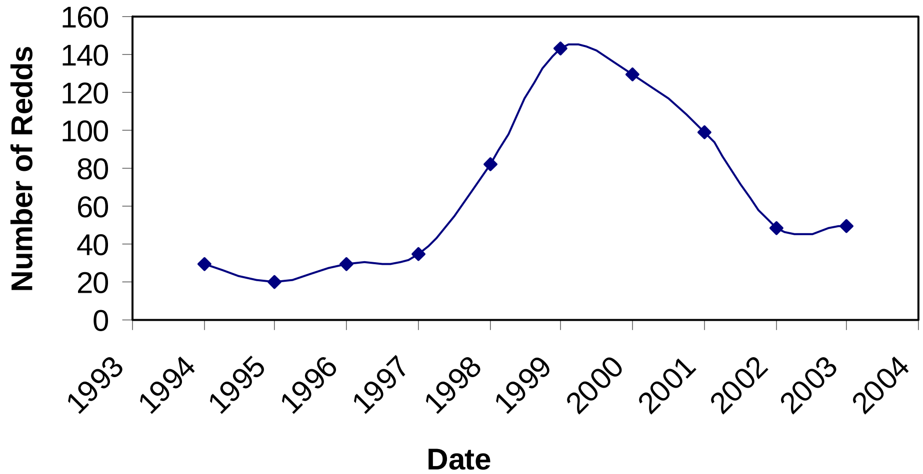


Figure 33. Bull trout redd counts in the North Fork Umatilla River from the confluence of Coyote Creek to the confluence of Woodward Creek. Data from ODFW, unpublished.

Bull trout redd counts are the only data available to monitor trends in abundance of bull trout in the Umatilla/Willow subbasin. There are statistical problems with using redd counts for detecting increasing or declining trends in bull trout populations (Maxwell 1999). Despite these problems it was determined by the Umatilla Bull Trout Working Group that redd surveys provided the most feasible method of estimating abundance available over the past decade. However, in 2003 the USGS Cooperative Fish & Wildlife Research Unit at Utah State University began a project to determine the abundance of bull trout in the North Fork Umatilla River (Budy et al. 2004). Preliminary data are available from this study and will be strengthened with planned continuation of the study over several years.

Preliminary work by Budy et al. (2004) provides a measure of confidence in using redd surveys to estimate bull trout populations. In 2003 Budy et al. (2004) used a mark-resight methodology to estimate population size in the North Fork Umatilla in 2003 and concluded that approximately 100 bull trout over 220 mm (i.e., sexually mature adults) exist there. Redd count data in 2003 provided an estimate that was similar. The number of spawners can be estimated using redd counts by assuming 2.5 spawners per redd. In 2003, 49 redds were counted in the North Fork which leads to an estimate of 123 adult spawners. The similarity in these two estimates of adult population size suggests that the adult bull trout population in the North Fork Umatilla in 2003 was approximately 100-123 individuals. The ten year average in the North Fork based on 2.5 spawners per redd is 165.

While bull trout have been documented in other streams within the subbasin such as the North Fork of Meacham Creek, South Fork Umatilla River, Iskuulpa Creek and Ryan Creek, no abundance data exist for these streams. However, abundance in these streams is anticipated to be quite low, much lower than in the North Fork Umatilla River. This assumption is based on the facts that few bull trout have been observed in these streams during fish surveys and the quality of habitat in these areas is poor relative to the habitat requirements of bull trout.

Life History

Bull trout are known to exhibit several different life history patterns including resident (life cycle is completed within the natal drainage), fluvial (spawning and 1 to 4 years of rearing occur in a tributary before migrating to a larger river), adfluvial (spawning and 1 to 4 years of rearing occur in a tributary before migrating to a lake) and anadromous (Hemmingsen et al. 2002). Both resident and fluvial life history patterns are known to exist in the Umatilla subbasin, but the relative abundance of each type is not well known. Radio telemetry was used in 1998-2000 (Germond 2000) and 2002-2003 (Sankovich et al. 2003) to learn about the movement patterns and life history characteristics of bull trout found in the upper mainstem Umatilla River during spring and early summer. Nineteen fish were tagged during the 1998-2000 study and 15 fish were tagged during the 2002-2003 study. Size of the fish averaged 480 mm (range 280 – 600 mm). In general two patterns were observed, a resident type and a fluvial type. Resident fish spent the summer and spawned in the North Fork Umatilla River and then over-wintered in an approximately five mile reach of the mainstem Umatilla River. The fluvial type spent the summer and spawned in the North Fork and then over-wintered in the mainstem Umatilla River, generally from RM 67 to RM 79. One fish was tracked as far downstream as RM 40.

This radio telemetry work, however, leaves the understanding of life history diversity incomplete due the limitations of the equipment. In order to have a radio tag of sufficient battery life to determine annual movement patterns, the tag must be relatively large, and therefore, fish of smaller size cannot be tagged. Thus a significant data gap exists regarding the life histories of smaller sized fish in the North Fork. It is possible that there are smaller resident fish that spend their entire lives in the North Fork Umatilla or other streams such as the North Fork Meacham, South Fork Umatilla, Ryan Creek or Iskuulpa Creek.

Additional information on the movement of juvenile and adult bull trout in the mainstem Umatilla River and Meacham Creek comes from the results of screw trapping conducted by the CTUIR fisheries program (Contor et al. 1995). A screw trap was operated in the mainstem Umatilla River 0.5 miles upstream from the confluence of Meacham Creek (RM 79) for 145 days from October 15, 1993 to July 19, 1994. One hundred forty-two bull trout were captured in the Umatilla River trap, with the majority trapped in April, May and October. Most bull trout trapped in the spring ranged in size from 100mm and 200 mm (juveniles) while those trapped in the fall ranged in size from 200 mm to 300mm (subadults and adults). The second trap was operated at RM 1 on Meacham Creek for 183 days from December 15, 1993 to June 22, 1994. During this time only two bull trout were captured in the trap. In addition to this information, a small number of juvenile and subadult bull trout have been observed at the Westland Diversion Dam juvenile fish trap (RM 27) and the Three Mile Falls Dam adult trap (RM 4).

The above information documents downstream migration of significant numbers of juvenile and subadult bull trout in the mainstem Umatilla River, presumably originating from the North Fork. And while there is some documentation of bull trout in the lower Umatilla River, the extent of migration by juvenile and subadult bull trout downstream of the screw traps discussed above is a significant data gap.

Almost all spawning activity documented occurs in the North Fork Umatilla River between the confluence of Coyote and Woodward Creeks, a three-mile reach of stream. Since 1994, three redds have been documented in the South Fork Umatilla upstream of Thomas Creek, four in the North Fork Meacham Creek, and two in Pot Creek (a tributary of the North Fork Meacham). Spawning occurs from early September through October.

Current and Historic Distribution

Because of poor water quality conditions in much of the Umatilla subbasin, bull trout are isolated in the headwaters of the Umatilla River and Meacham Creek (Figure 34). Currently, bull trout have been found from the headwaters of the Umatilla River to Three Mile Falls Dam (RM 4). It is presumed that these animals are simply migrating. It appears that spawning and rearing is restricted to the North and South Forks of the Umatilla River and the North Fork Meacham Creek. Annual comprehensive spawning surveys conducted between 1994 and 1996 by ODFW, USFS and CTUIR in known or suspected areas of spawning indicate that the majority (81 to 92 percent) of redds are in the North Fork Umatilla River between the confluences of Coyote and Woodward Creeks (Northrup 1997). Radio telemetry studies indicate that the majority of migratory fish move downstream to the reach of the Umatilla mainstem between Cayuse (RM 67) and the confluence of Meacham Creek (RM 79) in the winter months. Resident life history fish use the reach of the mainstem upstream of Meacham Creek in the winter months. Summertime rearing occurs in the mainstem from the confluence of Meacham Creek upstream to the forks. Year-round use also occurs in Iskuulpa Creek, Ryan Creek, North Fork Umatilla River, Coyote Creek, Shimmiehorn Creek and Meacham Creek (Germond et al. 1996).

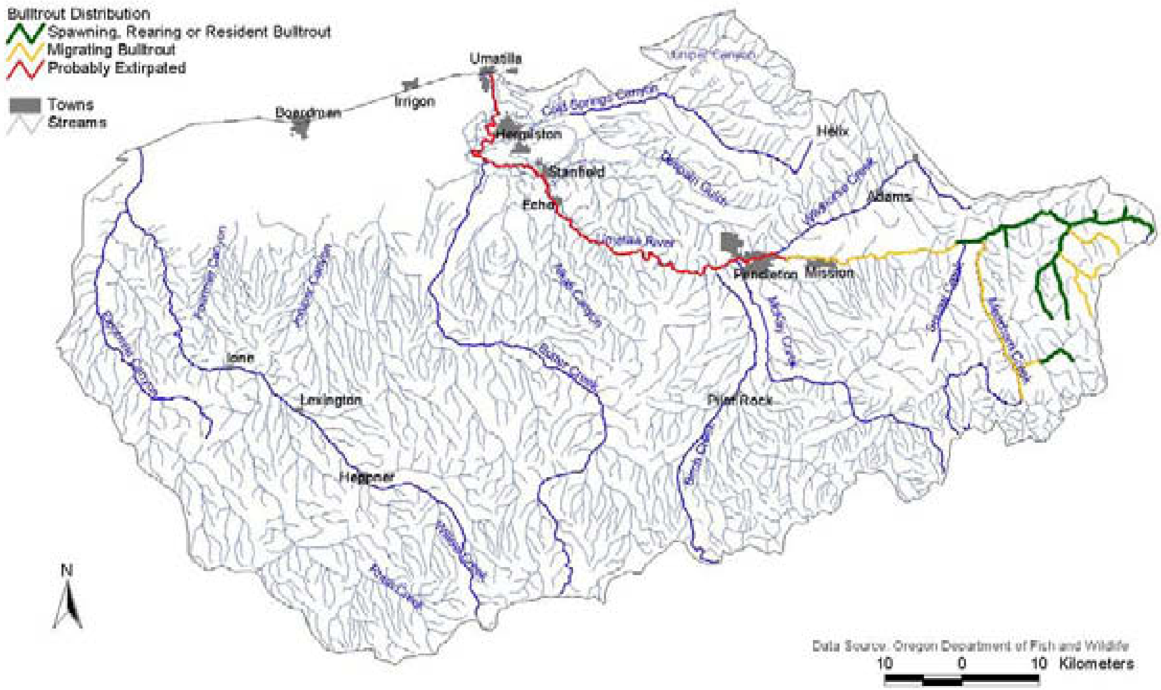


Figure 34. Bull trout distribution, spawning and rearing areas in the Umatilla/Willow subbasin.

Little information exists regarding the historical distribution of bull trout in the subbasin. Recent sightings of bull trout in the mid- and lower Umatilla River and in lower McKay Creek suggest that, in addition to the current distribution, these reaches might have had important historical use and are used only infrequently now and are not considered viable bull trout habitat as a result of degraded stream conditions (Figure 34).

Bull trout require substrate with little sediment, complex habitat, and cold water. As a result of anthropogenic activities much of the Umatilla River mainstem and many of its tributaries have lost suitable habitat for bull trout. This loss has come about through a variety of means. Some of the most important include: the removal of riparian vegetation resulting in a loss of large woody debris into the streams; increased sediment input into the streams which decreases the suitability of the substrate for spawning and rearing, and increased channelization of reaches of streams which leads to a loss of habitat (e.g., slack water areas by meanders) and a decrease in an exchange of cold groundwater. These factors are covered in greater detail in sections 3.1.1.9, 3.1.3.2 and 3.5.1.

Population Risk Assessment

The DBTRP identifies two local populations of bull trout in the Umatilla/Willow subbasin, the Upper Umatilla River including the North and South forks, and Meacham

Creek including the mainstem from the mouth to the confluence of the North Fork and the North Fork including Pot Creek (Figure 32). Buchanan et al. (1997) identified three bull trout populations within the Umatilla subbasin: the North Fork Umatilla, South Fork Umatilla and Meacham Creek Populations. The Recovery Unit Team (a local team established to write the recovery plan) decided to lump the populations in the North and South forks due to the low number of bull trout found in the South Fork and the marginal nature of the habitat for supporting bull trout. The Meacham Creek population has declined from the 1991 status report (Buchanan et al. 1997) and the persistence of bull trout in the Umatilla was considered tenuous by biologists from USFS, CTUIR and ODFW (Northrop 1997).

A five category classification scheme developed by ODFW regarding a population's risk of extinction is shown in Table 32. This scheme was used to describe the Umatilla/Willow subbasin's bull trout populations in 1991 and 1996 (Table 33). Over this period of time the status of the North Fork population declined from "Low Risk" to "Of Special Concern" and the Meacham Creek population was considered to be at high risk of extinction because of relatively poor habitat, warm water temperatures, and low abundance (Buchanan et al. 1997).

In response to perceived population declines, protective angling regulations have been in place since 1989 and harvest of bull trout closed in 1994. A prohibition on angling for bull trout has been in place since 2002. Tribal angling accounts for some harvest, but most tribal members release bull trout (Buchanan et al. 1997).

Table 32. The five category classification system for bull trout populations. Table modified from Buchanan et al. (1997).

Category	Life History Stagea	Abundance	Distribution	Habitat	Contact with Non-native Trout	Recovery Potential
Low Risk	Large size	High	Dipersed	Excellent	None	Not required
Of Special Concern	↕	↕	↕	↕	↕	↕
Moderate Risk						
High Risk	Small size	Very low	Isolated and Fragmented	Poor	High	Major effort required
Probably Extinct						

a Large fish size assumes migratory fluvial or adfluvial bull trout while small fish size assumes resident bull trout

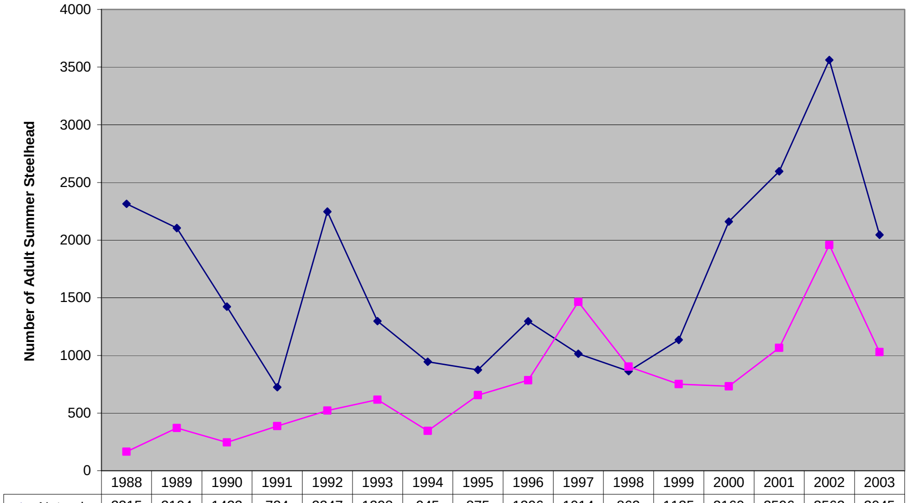
Table 33. Status of bull trout populations in the Umatilla subbasin (1991 status: Ratliff and Howell 1992; 1996 status: Buchanan et al. 1997).

Population	1991 Status	1996 Status
North Fork Umatilla River	Low Risk	Of Special Concern
Meacham Creek	Not Identified	High risk

Summer Steelhead

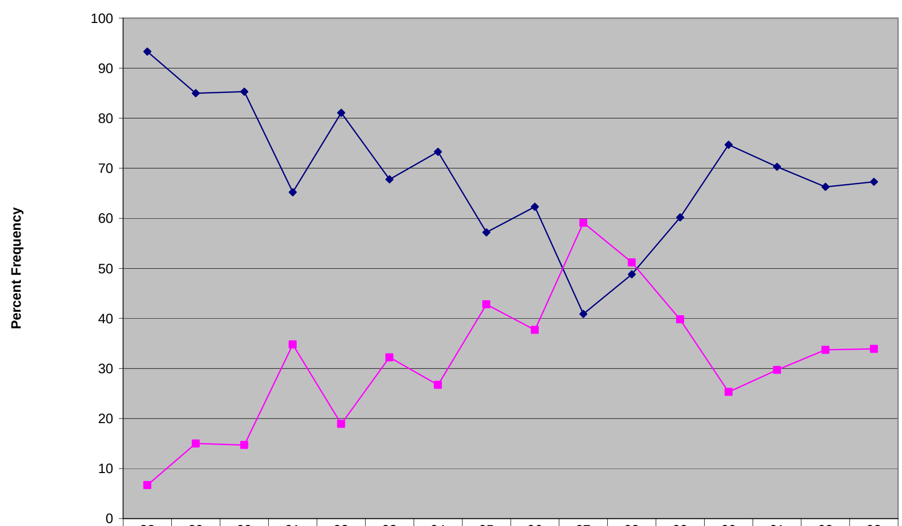
Abundance and Population Trends
The total return of adult natural and hatchery summer steelhead has been recorded at Three Mile Falls Dam (TMFD) since 1988. The run has varied between a minimum of 1,111 (in 1991) and a maximum of 5,520 (in 2002) adults, with an average 2,412 adults (Figure 35). The natural component of the return to TMFD has varied between 724 (in 1991) and 3,562 (in 2002) adults, and has averaged 1,663 adults. The return of hatchery summer steelhead to TMFD has varied between 165 (in 1988) and 1,958 (in 2002) and averaged 749 adults. From 1988-2003 the naturally reared component of the return ranged from 40.9% to 93.3% (mean 68.9%) of the total steelhead return to TMFD (Figure 36). From 1999 to 2002 there has been an increase in the number of adult steelhead returns to TMFD (Figure 35). However, only in 2002 did these numbers approach the Umatilla/Willow Subbasin Plan objective of 4,000 natural fish and 1,500 hatchery fish.

It is difficult to determine the exact mechanism behind the increase in returns starting in 1999. However, in 1999 there was an apparent phase shift, from positive to negative, in the Pacific Decadal Oscillation (TOAST 2004). Since the negative phase creates favorable ocean conditions for Columbia basin anadromous fish, it is possible that the high returns in 2001-2002 reflect good marine conditions and that when another phase shift occurs, a downward trend in numbers of returning adults will be observed.



	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Natural	2315	2104	1422	724	2247	1298	945	875	1296	1014	862	1135	2160	2596	3562	2045
Hatchery	165	370	245	387	522	616	345	656	785	1463	903	751	732	1066	1958	1029

Figure 35. Natural and hatchery summer steelhead adult returns to TMFD between 1988 and 2003. Data provided by CTUIR, DNR Fisheries Program.



	88	89	90	91	92	93	94	95	96	97	98	99	00	01	02	03
Natural	93.3	85	85.3	65.2	81.1	67.8	73.3	57.2	62.3	40.9	48.8	60.2	74.7	70.3	66.3	67.30
Hatchery	6.7	15	14.7	34.8	18.9	32.2	26.7	42.8	37.7	59.1	51.2	39.8	25.3	29.7	33.7	33.90

Figure 36. Percent natural and hatchery summer steelhead adults returning to TMFD, 1988-2003. Data provided by CTUIR, DNR Fisheries Program.

Juvenile abundances of steelhead have been estimated at 25 index sites in the upper Umatilla River and its tributaries by the CTUIR (Contor and Sexton 2003). Index sites ranged from 100-300 meters long and abundances were estimated using block nets and multiple electrofishing passes (up to three). Figure 37 shows the catch-per-unit effort averaged across the 25 index sites and reveals a declining trend in juvenile abundance over the surveyed years. However, enough variability among sites exists that it is difficult to determine whether this trend is significant and whether it will continue in the future.

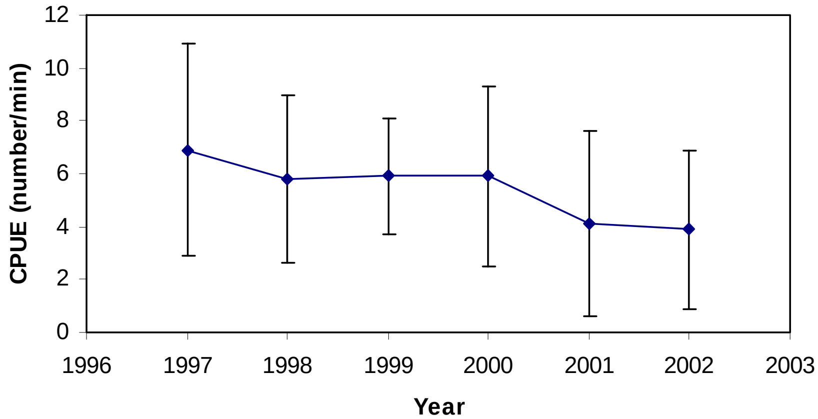


Figure 37. Average annual catch-per-unit effort (CPUE) and standard deviations from 25 index sites in the upper Umatilla River and its tributaries. Data from Contor and Sexton (2003).

Additional data on numbers of steelhead adults counted at TMFD, disposition, escapement, and harvest for run years 1987/1988 to 2001/2002 can be found in Table 1 of Appendix B.

Productivity

Data collected on summer steelhead in the Umatilla/Willow subbasin allow three measures to be made that examine trends in productivity at different life stages. The first measure is an estimate of the number of redds and the relationship between this number and spawning escapement (i.e., the total number available for spawning measured as the number counted at TMFD minus the number taken for broodstock and the estimated number harvested upstream). This measure of productivity provides an estimate of the number of fry produced within the subbasin. The second measure is an estimate of the total number of smolts produced and the number of smolts per spawner. This provides an estimate for a given brood year of the number of salmon leaving the subbasin both in total and per spawner. Finally, productivity can be estimated as the number of returning adults produced per spawning adult. A value of 1 for this ratio indicates that the population is “replacing” itself; in other words, for every reproducing adult, one adult returns to the subbasin. Values greater than 1 suggest that the population is growing and values less than 1 indicate a declining population.

<u>Spawning escapement and redd numbers</u>: Female escapement increased dramatically from 1999 to 2001 (Figure 38). During the same time, redd surveys conducted by the CTUIR indicate that the number of redds per mile also increased (Figure 39). These two values, female escapement and redd density, are tightly correlated (Figure 40).

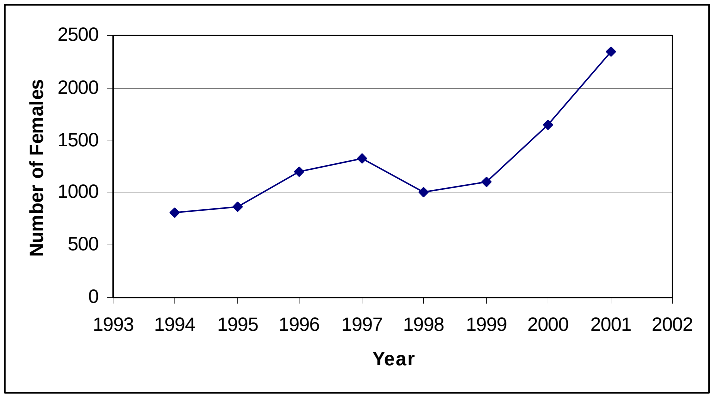


Figure 38. Female spawning escapement in the Umatilla River. Data from Kissner (2003).

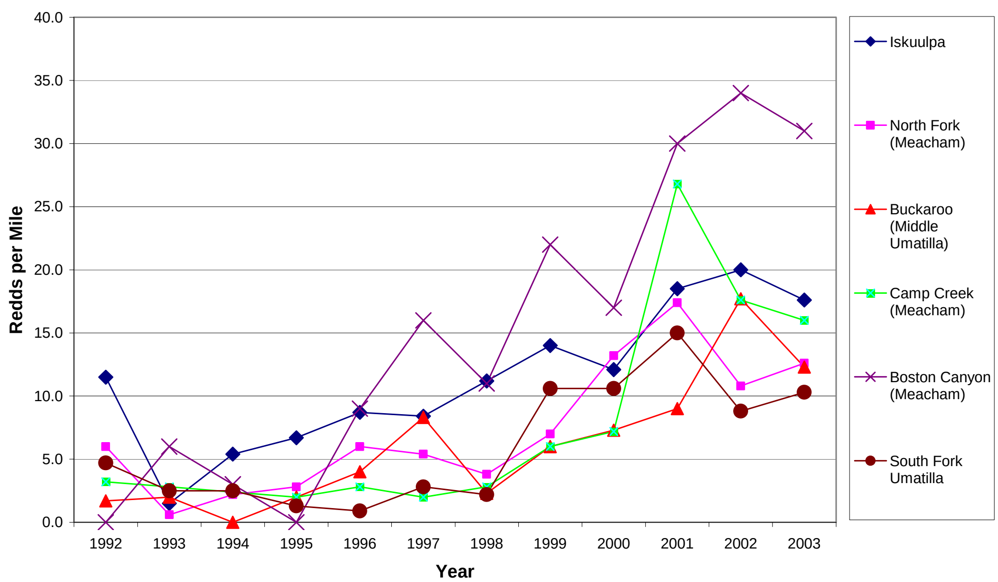


Figure 39. Average redds per mile at six index sites (all are Umatilla River tributaries). Data provided by CTUIR, DNR Fisheries Program.

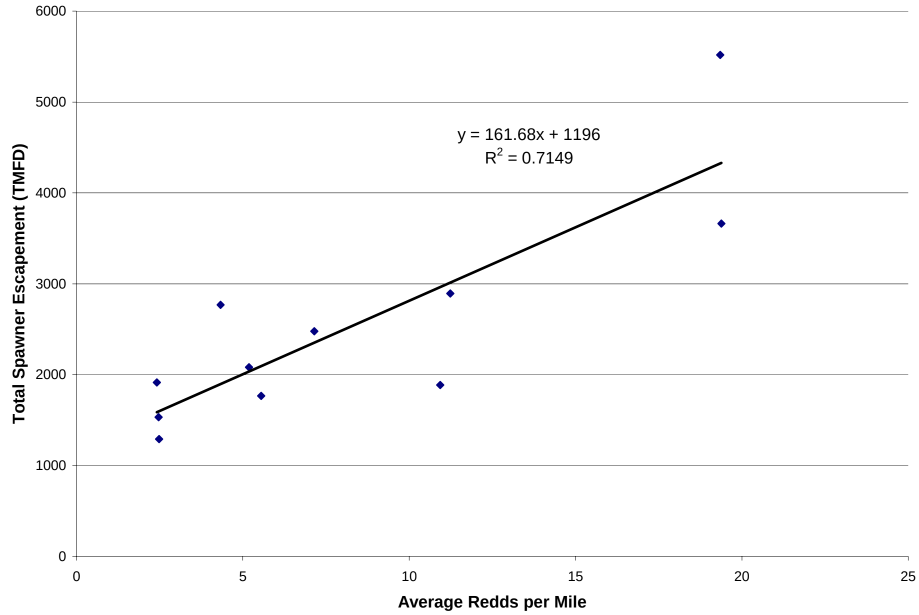


Figure 40. Regression between average redds per mile at six index sites and total spawner escapement to TMFD. Data provided by CTUIR, DNR Fisheries Program.

The increasing number of steelhead redds in the subbasin and the relationship between spawning escapement and number of redds suggest that steelhead productivity is increasing in the subbasin. However, the other measures of productivity do not necessarily support this conclusion.

Number of smolts: The number of smolts leaving the subbasin was estimated from 1995 to 1999. During this time the number of smolts peaked in 1998, but showed no obvious trend over time (Figure 41). Similarly, the ratio of the number of smolts to spawning escapement (an estimate of the number of smolts produced per spawner) peaked in 1998, but also showed no trend over time (Figure 42).

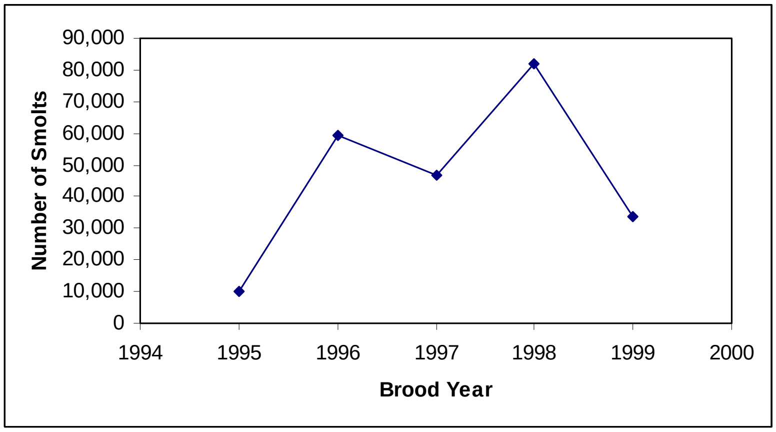


Figure 41. An estimate of the number of steelhead smolts leaving the Umatilla River based on captures of smolts near the Umatilla River's mouth. Data from Chess et al. (2003).

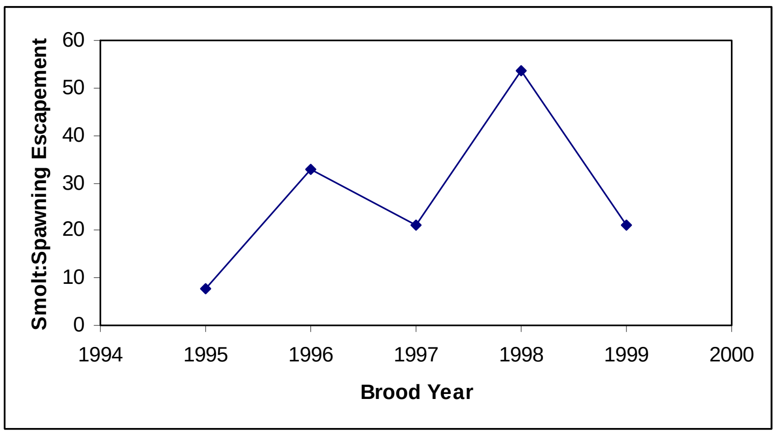


Figure 42. The smolt to spawner escapement ratio for a given brood year. Data from Chess et al. (2003).

No obvious trends in the number of smolts or smolts per spawner exist during the dates when data are available. Because data do not exist for the number of smolts after 1999, it cannot be determined whether the number of smolts increased during the same period that the number of redds increased (1999-2003, Figure 39).

<u>Number or returning adults per spawner</u>: Perhaps the most important measure of productivity is the number of adults that come back to the subbasin per spawning adult. This is the most direct measure of whether, through natural production, a population is growing, replacing itself, or declining. The ratio of progeny (number of returning adults) to spawning escapement for brood years from 1988 to 1997 is shown in Figure 43. In only two years, 1988 and 1996, has the progeny to adult ratio exceeded 1. However, unpublished data indicate that 1998 brood will also produce returns greater than 1.0, but information on 5 year olds is currently not available (personal communication: J.

Schwartz, CTUIR, April, 2004). In two years, 1994 and 1995, returns were almost at replacement; however, in all other years, returns were below replacement (Figure 43). These data reveal that with natural production alone the population would decline (because for six of ten years the ratios are below 1).

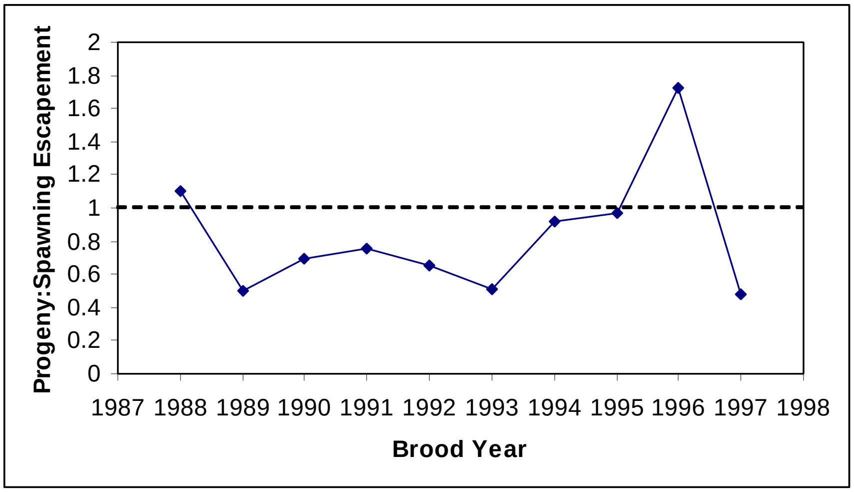


Figure 43. Natural productivity of steelhead in the Umatilla/Willow subbasin as estimated by the number of progeny (adult returns) to the total spawning escapement. A value of 1 indicates that the population is replacing itself (i.e., one returning adult for each spawning adult). Data from Chess et al. (2003).

<u>Productivity associated with hatchery vs. natural adults</u>: An important question regarding productivity of steelhead and salmon populations that are supplemented by hatchery-reared fish is whether hatchery-reared fish contribute to natural production and how that compares to production by naturally-reared fish. Observations at steelhead spawning grounds suggest that hatchery-reared fish contribute to natural production to a similar level as naturally-reared fish. In 2001, 23 observations were made of spawning individuals in which the identity (natural vs. hatchery) could be determined. Hatchery-reared fish made up 26.1% of the spawners and naturally-reared fish made up the other 73.9%. In the same year, the fish available to spawn were 26.6% hatchery-reared and 73.4% naturally-reared. In 2002 a similar trend was found. Hatchery-reared fish made up 45.2% of the observed spawners and naturally-reared fish made up the other 54.8% (from a total of 42 observations), and the fish available to spawn were 34.7% hatchery-reared and 65.3% naturally-reared (Kissner 2003).

Life History

Steelhead display two broad life history patterns often called “summer” and “winter”. General life history traits of these two types are summarized in a report by WDFW and ODFW (2002). Summer steelhead adults return to the Columbia River from March through October after having spent from one to three years in the ocean. Adults spawn from January to June in the year following their entry into freshwater. Juvenile summer steelhead will smolt and migrate to the ocean in May and June. Most wild summer steelhead migrate to the ocean at age 2, while most hatchery smolts migrate at age 1. In contrast, winter steelhead return to the Columbia River from November through April after having spent two years in the ocean. Adults spawn from December through June. Juvenile winter steelhead smolt and migrate to the ocean in May and June. Wild winter steelhead juveniles spend two or three years rearing in freshwater, while hatchery juveniles spend only one year rearing in freshwater.

Only summer steelhead are found in the Umatilla/Willow subbasin. Umatilla River summer steelhead adults typically enter the Columbia River from the Pacific Ocean in June through August of the year before spawning. Entry into the Umatilla River begins in August, peaks in March and is mostly complete by May 1 (Figure 44) (Kissner 2003). On average, 67.2% of the natural and 67.5% of the hatchery adult return is enumerated at Three Mile Falls Dam in a four mouth period between December and March.

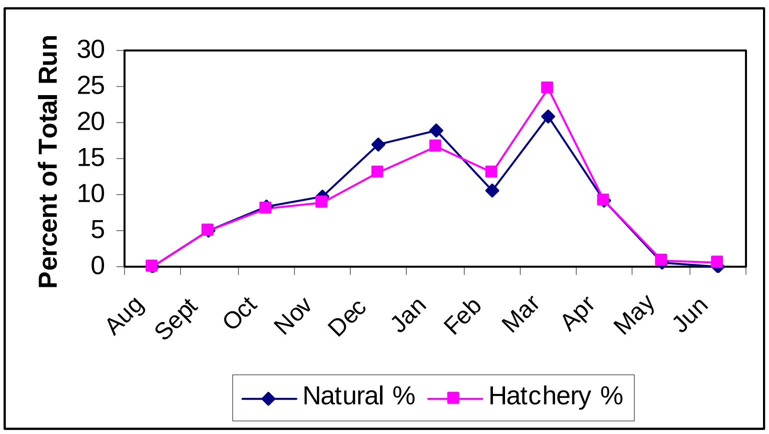


Figure 44. Adult summer steelhead time of entry into the Umatilla River (as measured at TMFD), averaged over the run years of 1994-2000. Data from Kissner (2003).

Spawning has been observed as early as mid-February, peaks in early to mid-April, and is mostly complete by June 1 (Kissner 2003). Redd surveys indicate the same timing of spawning, with redds first observed in index reaches in early March and the number peaking in early April and declining by mid- to late May (Figure 45) (Kissner 2003).

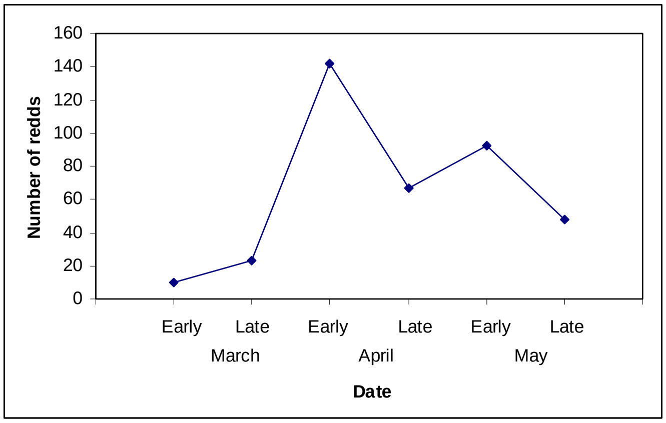


Figure 45. 2001 summer steelhead redd timing in index reaches in Umatilla River tributaries (Camp Creek, Iskuulpa Creek, Buckaroo Creek, South Fork Umatilla, North Fork Umatilla, Meacham Creek, and Boston Canyon Creek). Data from Kissner (2003).

Juveniles emerge from the gravel in late April through early July and most rear for two winters before migrating from the Umatilla River. Based on collections from rotary screw traps near the mouth of the Umatilla River, downstream migration of presmolt and/or smolt begins in October (Chess et al. 2003). However, large numbers are not observed until the following spring when outmigrating smolt numbers peak from early April to late May depending upon the year (Figure 46).

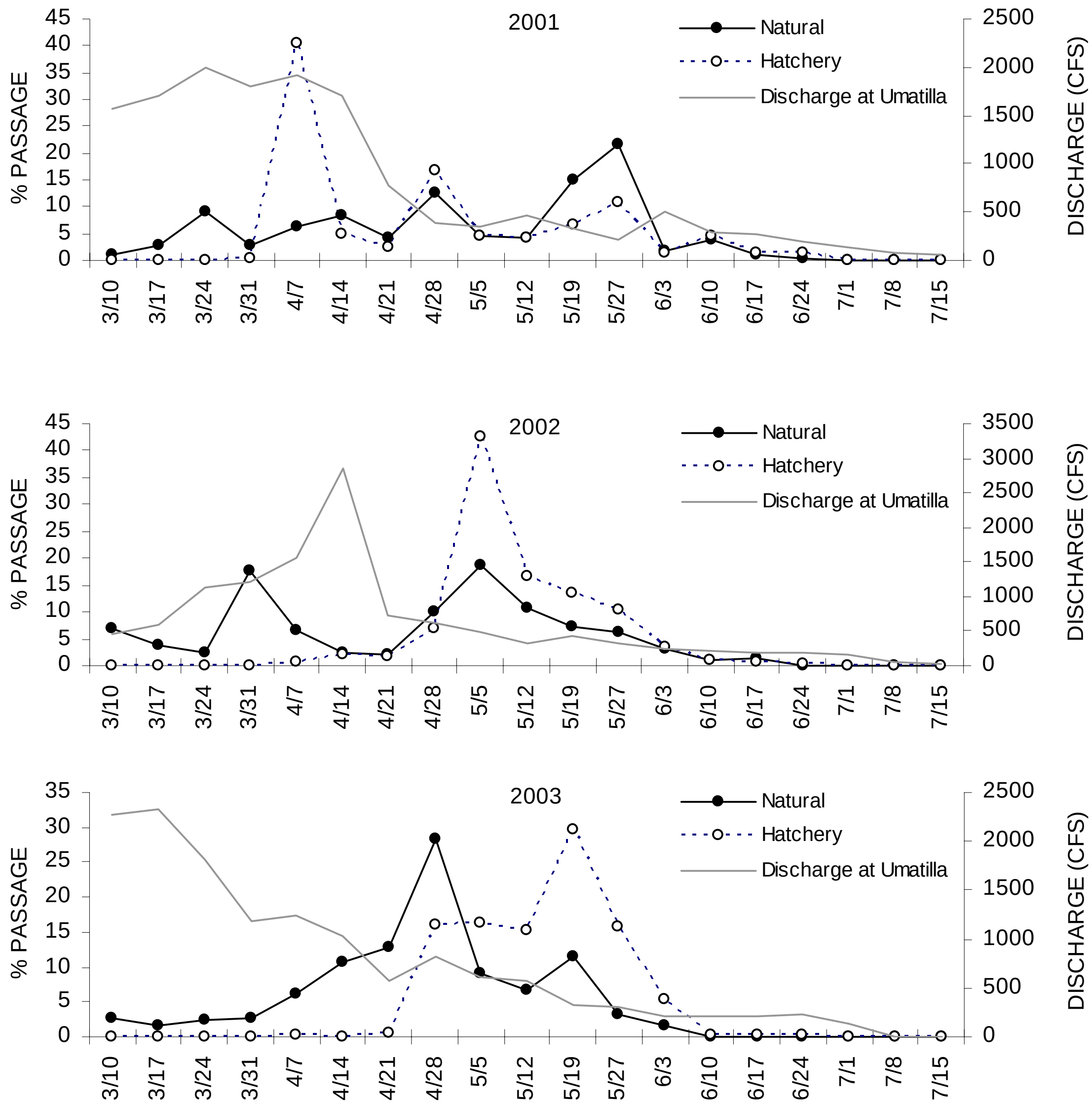


Figure 46. Migration timing of natural and hatchery summer steelhead smolts counted at TMFD during 2001, 2002, and 2003. The percentages were from weekly totals of fish divided by the respective total for the outmigration period. Daily flow data at the lower Umatilla River gauge (RM 2.1) were averaged on a weekly interval. Figure provided by ODFW, April, 2004.

One important source of life history diversity within the population is variation in the amount of time spent rearing in the subbasin and the amount of time spent in the ocean. Adults spawn after one (66.9% of the population) or two (33.1%) years of ocean residency. No differences exist between hatchery and natural fish in the duration of ocean residency (Chess et al. 2003). Freshwater residency lasts two or three years, with a very few males staying in freshwater for four years. Figure 47 summarizes these life history patterns for the Umatilla/Willow subbasin population.

While steelhead are known for being iteroparous (individuals spawn multiple times), repeat spawners in the Umatilla/Willow subbasin are rare; repeat spawners account for less than 5% of the return (personal communication: P. Kissner, CTUIR, March, 2004).

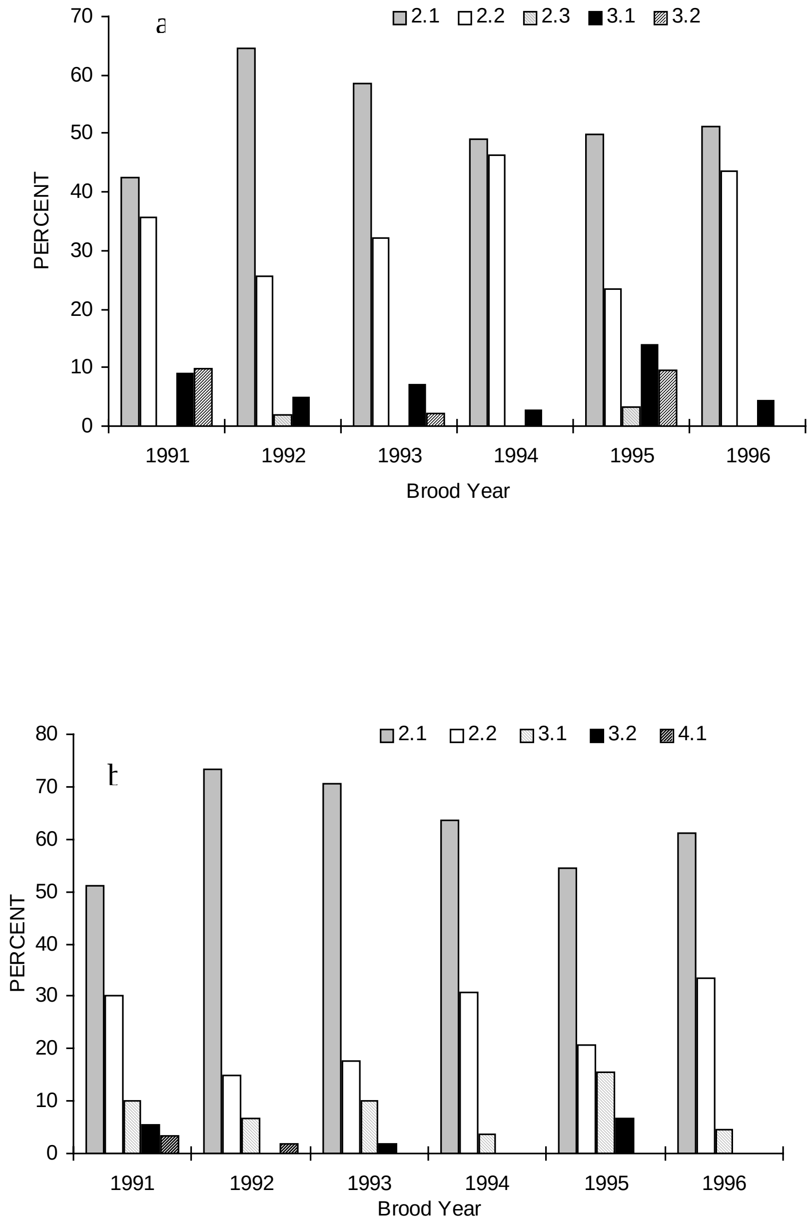


Figure 47. Proportion of natural a) females and b) males returning to TMFD that display a specific life history pattern. Numbers refer to the number of years spent in freshwater (the first number) and in the ocean (the decimal or second number). Age was determined by scale analysis. Figure from Chess et al. (2003).

Within the subbasin there is a fair amount of life history diversity in terms of use of areas within the subbasin. Most spawning occurs in the upper Umatilla mainstem and upper and middle tributaries with some spawning occurring in the middle mainstem. Movement of juveniles is mostly downstream; however, there is a fair amount of movement between the mainstem and tributaries. This movement and the timing of outmigration are summarized in Figure 48.

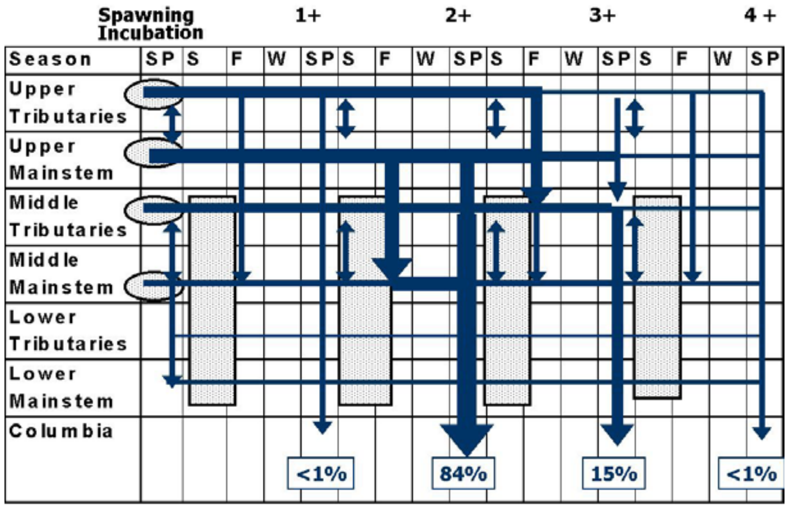


Figure 48. Life history of summer steelhead within the Umatilla/Willow subbasin. Shaded ovals represent areas and times when redds are at risk from scouring and/or sedimentation during high flows. Shaded rectangles represent times and areas where high water temperatures may be limiting Figure from Contor et al. (1998).

Genetic Diversity

Hatchery releases of non-native steelhead commenced in the Umatilla River in 1967 with the introduction of Skamania steelhead. Skamania steelhead were a mixture of coastal steelhead from the Klickitat and Washougal rivers. Since 1980 adults for broodstock have mostly been natural returns collected at TMFD. Usually about 10 hatchery returning males (from natural brood in the previous generation) are also taken and used when necessary.

Results of genetic sampling in 1992 and 1994 indicated that so much genetic variation existed in juvenile redband/steelhead from within a sampling location that it was difficult to detect geographic patterns among fish from different tributaries within the subbasin or to differentiate redband trout from steelhead (Currens and Schreck, 1995).

Current and Historic Distribution
Umatilla River summer steelhead spawning tributaries have been divided into major, medium, and minor producers based on observed escapements and estimated production potential. Major producers are drainages with an estimated natural production potential of over 500 adults annually, medium producers are drainages with production potential of 100-500 adults annually, and minor producers have production potential of less than 100 adults. Major producers, ranked in order of importance, are Meacham Creek and its tributaries and Birch Creek and its tributaries. Medium producers, also ranked in order of estimated importance, are Upper Mainstem Umatilla, South Fork and its tributaries and Iskuulpa Creek. Minor tributaries are the North Fork Umatilla, Buckaroo Creek, Ryan Creek, Minthorn Springs, Bear Creek, Coonskin Creek, McKay Creek, Mission Creek, and Moonshine Creek.

The mainstem Umatilla River is critical rearing habitat for naturally produced summer steelhead. Large numbers of young-of- the-year and lesser numbers of age 1 and 2 juvenile summer steelhead have been observed in the mainstem during escapement surveys and electroshocker sampling. It appears that most of these fish were spawned in lateral tributaries and migrated to the mainstem to rear, as only small numbers of summer steelhead have been observed to spawn in the mainstem (Paul Kissner, CTUIR, unpublished data). The importance of the North Fork Umatilla River to natural summer steelhead production, although it is only a minor summer steelhead spawning and rearing tributary, cannot be overstated. During the critical low summer flow period the influence of cold water from the North Fork moderates high summer temperatures in the upper mainstem and juvenile rearing can occur downstream to Cayuse (RM 67.5). In the mainstem below the McKay Creek confluence (RM 50.5) limited rearing is again possible because of releases of cool water from McKay Reservoir.

Little is known of historical summer steelhead distribution in the Umatilla/Willow subbasin. Oral testimony of tribal members and others indicate that McKay Creek above the reservoir, Butter Creek and Wildhorse Creek historically had spawning summer steelhead (Swindell 1942). Thus, the current spawning distribution is greatly reduced compared to the historic one (Figure 49). In addition, adult steelhead are occasionally found in Willow Creek and a population of resident redband trout is found there; thus it is likely that this creek and its tributaries historically had a population of steelhead. However, a population does not currently exist in Willow Creek as a result of passage problems and the absence of good rearing habitat.

As in most subbasins in the Pacific Northwest that produce natural or wild summer steelhead, anthropogenic impacts in the Umatilla/Willow subbasin have caused major declines in summer steelhead abundance and distribution. The subbasin’s adult and juvenile summer steelhead populations have been affected by a variety of human activities that have led to channelization and loss of instream habitat, decreased instream water volume and increased water temperatures, and increased sediment input. These factors are covered in greater detail in Sections 3.1.1.9, 3.1.3.2, and 3.5.1. The distribution of summer steelhead in the Umatilla River has probably been most affected by the construction of McKay Dam, which blocked access to over 30 miles of spawning and rearing habitat. Another major change in summer steelhead distribution was caused by the blockage of Butter Creek by irrigation diversions. Passage problems are also the most likely factor contributing to the extirpation of steelhead in Willow Creek. Passage is blocked during most of the year in Willow Creek below Heppner by diversion dams. Flows in Willow Creek are only substantial enough in the spring to allow passage of remnant mid-Columbia steelhead over the diversion dams located downstream of Heppner (personal communication: K. Ramsey, USFS, January 2004). In addition, Willow Creek Dam was constructed in 1983 upstream of Heppner (at RM 55.5) as a flood control measure. This dam effectively blocks any passage of steelhead and cuts off the upper 24 miles of Willow Creek as well as the upper tributaries.

In addition to passage barriers, unscreened water diversions also have a substantial impact on anadromous fish. Although all known gravity feed diversions in the anadromous portion of the Umatilla subbasin are screened, it is not known to what extent pump diversions have been screened in the anadromous portion of the subbasin. In addition, although the total number of unscreened diversions in Butter and Willow Creeks is unknown, several diversions on Willow Creek are known to lack screens (personal communication: K. Ramsey, USFS, January 2004).

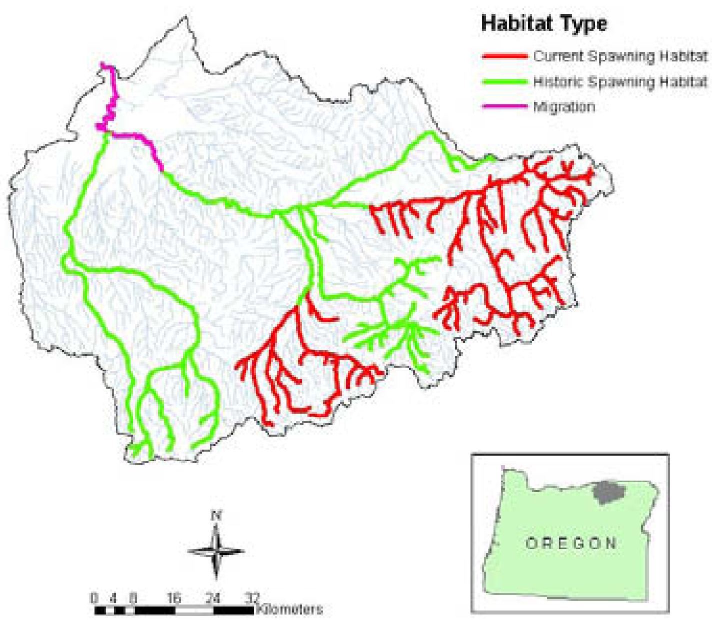


Figure 49. Current and historic distribution of spawning habitat for summer steelhead in the Umatilla River subbasin. This figure does not include the Willow Creek subbasin which was most likely spawning habitat for summer steelhead historically.

The distribution of rearing summer steelhead has most likely been impacted by warm temperatures in the lower sections of the Umatilla River and Willow Creek and by the loss of rearing habitat in the mainstem Columbia River. High water temperatures caused by the ponding of flow in the reservoirs make these areas currently of little value for rearing, except during the winter and spring. While it is unclear how important the Columbia River was for summer steelhead rearing, evidence from Alaska suggests that large rivers can be important habitat for juvenile steelhead overwintering and rearing.

Spring Chinook

Abundance and Population Trends

The total return of spring Chinook salmon to TMFD since the first adult return in 1988 has varied between 13 (in 1988) and 5,061 (in 2002) and averaged 1,968 adults. Annual return of jack spring Chinook salmon during this period varied between 3 and 210. In 1996 the first naturally produced adults returned to TMFD and naturally produced adults have returned each year since then (Figure 50). However, during this time hatchery adults have comprised the great proportion of the return (from 84% to 98.8%). The estimated natural component of the adult return to TMFD from 1996-2003 has varied between 22 (in 1999) and 348 (in 2000) and averaged 158 adults. As with steelhead, between 1999 and 2002 an increasing number of adults have returned to TMFD and it is possible that this reflects a phase shift in the PDO to more favorable ocean conditions.

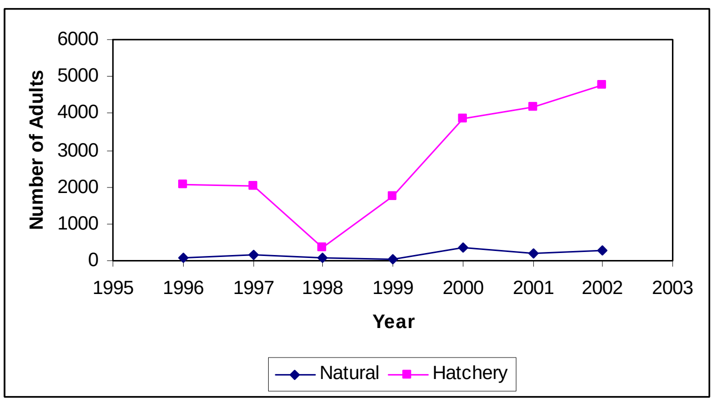


Figure 50. Spring Chinook adult returns to TMFD. Data from Kissner (2003).

Juvenile abundances of spring Chinook have been estimated through electrofishing at 25 index sites in the upper Umatilla River and its tributaries by the CTUIR (Contor and Sexton 2003). Figure 51 shows the catch-per-unit effort averaged across the 25 index sites. The number of juveniles caught varied across years and varied greatly between sites within years (as revealed by the large standard deviations in Figure 51). In contrast to adult returns to TMFD, no obvious trend in juvenile numbers exists across years.

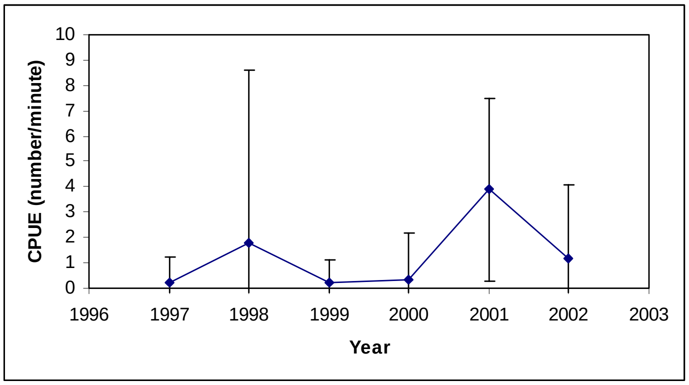


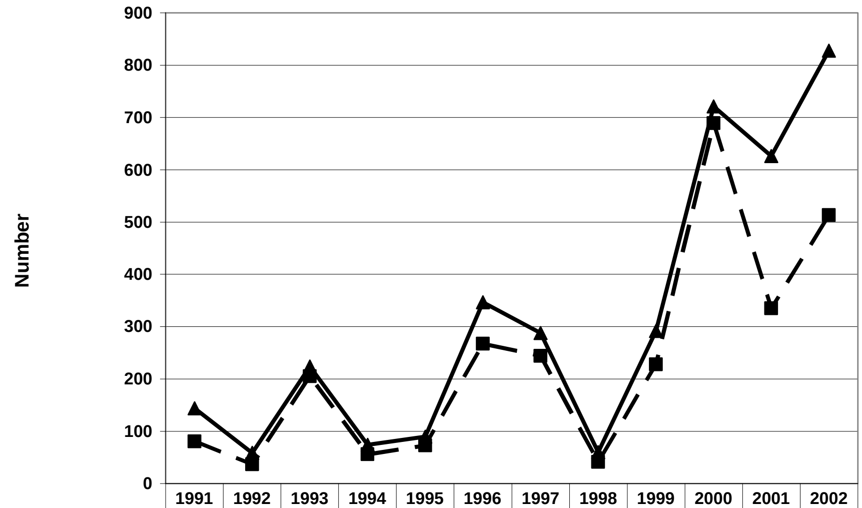
Figure 51. Average annual catch per unit effort (CPUE) (± 1 standard deviation) from 25 index sites in tributaries of the Umatilla River for juvenile spring Chinook. Data from Contor and Sexton (2003).

Additional data on numbers of spring Chinook adults counted at TMFD, disposition, escapement, and harvest from 1989 to 2002 can be found in Table 2 of Appendix B.

Productivity

As with steelhead, data exist to estimate spring Chinook productivity in three ways, the number of redds and redd to spawner ratio, the number of smolts and smolt to spawner ratio, and the number of adults returning to spawner ratio.

Spawned females and redd numbers: Because spring Chinook spawn over a fairly small area in the Umatilla/Willow subbasin (see Figure 59) it is possible to get a count of the number of females that actually spawned by an examination of carcasses. This is a much more accurate measure of the number of individuals that spawn than spawning escapement. A tight relationship exists between the number of spawners and the number of redds (based on a linear regression analysis, $R^2 = 0.88$, $p < 0.001$) (Figure 52). As with steelhead, the number of redds and the number of spawners increased from 1999 to 2002, suggesting an increase in productivity in this system (Figure 52). However, the number of spawners is a function of the number of returns to TMFD, and thus this apparent increase in productivity could reflect improved ocean conditions and not necessarily changes within the subbasin.



	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Redds observed	144	59	224	74	90	347	288	60	292	721	626	828
Spawned females	81	37	205	56	73	267	244	41	228	689	335	513

Figure 52. The number of spring Chinook spawned females and redds counted in spawning reaches. Figure from Kissner (2003).

<u>Number of smolts and smolts per spawner:</u> The number of spring Chinook smolts leaving the subbasin was estimated from 1995 to 1999 using a irrigation canal bypass trap (in 1995 and 1996 at RM 3.7) and rotary screw traps (in 1997, 1998, and 1998 at RM 1.2). During this time the number of smolts peaked in 1997, but showed no obvious increasing or decreasing trend over time (Figure 53). The ratio of the number of smolts to the number of adult carcasses peaked in 1998 (Figure 54) because of a large drop in the number of adult carcasses found in 1998 relative to 1997 (Figure 52). Again, no obvious trend over time exists for this measure of productivity (Figure 54).

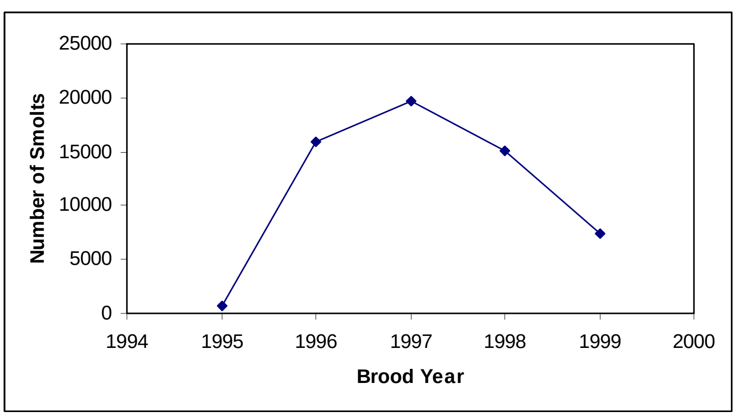


Figure 53. An estimate of the number of spring Chinook smolts leaving the Umatilla River based on captures of smolts near the Umatilla River's mouth. Data from Chess et al. (2003).

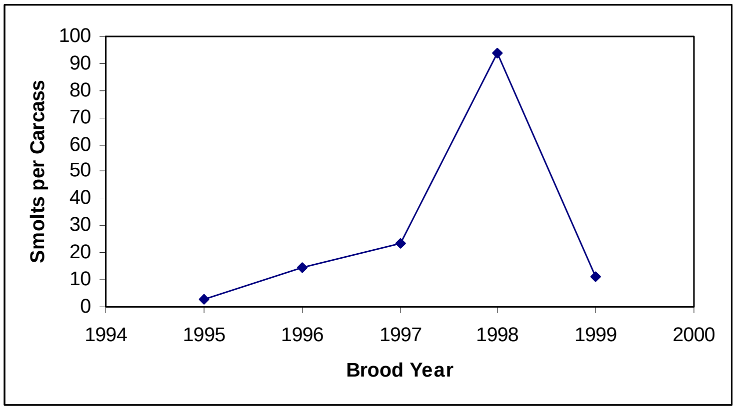


Figure 54. The smolt to adult carcass ratio for a given brood year. Data from Chess et al. (2003).

<u>Number of returning adults per spawner</u>: This measure of productivity was estimated by determining the total number of adult returns for a given brood year divided by an estimate of the number of adults that successfully spawned (based on the proportion of carcasses found that were spawned out). A value of 1 for this measure indicates that the population is replacing itself and values greater than 1 indicate that the population is growing. For the six years in which data are available to calculate this measure of productivity, the value exceeded 1 only in the first year (in 1992), and was low with no obvious trend for the five years after that (Figure 55). Thus, natural production by spring Chinook is not replacing the small population that currently exists in the subbasin.

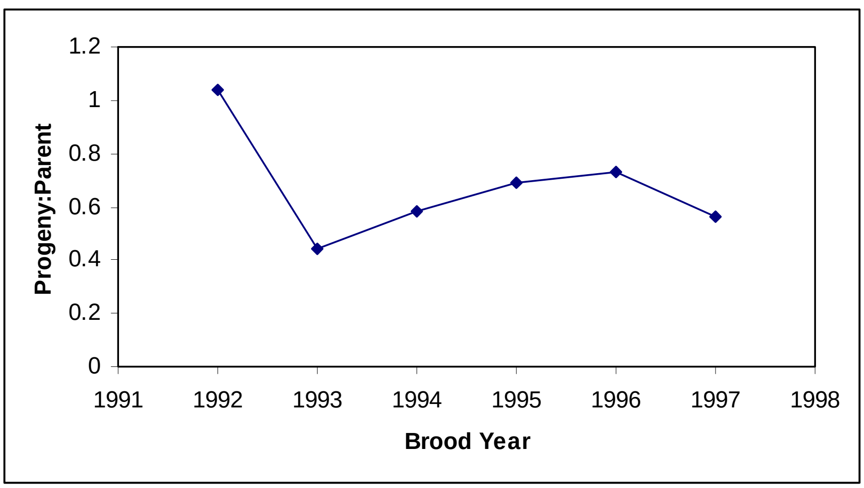


Figure 55. Natural productivity of spring Chinook in the Umatilla/Willow subbasin as estimated by the number of progeny (adult returns) to the total spawning escapement. Data from Chess et al. (2003).

Life History

The endemic spring Chinook population went extinct in the Umatilla/Willow subbasin in the early 1900s. In 1986 spring Chinook salmon were re-introduced into the subbasin. These fish were from Carson Hatchery Stock which is a mixture of upriver spring Chinook races that spawn above Bonneville Dam. This stock enters the Columbia River from the ocean from February through April. Entry into the Umatilla River begins in late March, peaks in May, and is mostly complete by the end of June (Zimmerman and Duke 1996). The majority (approximately 75%) of a run enters the Umatilla River in May. Adult returns to the subbasin from natural spawners began in 1996, but make up only a small percentage of the total adult returns (Figure 50).

Natural Umatilla River spring Chinook salmon adults return to spawn after two or three years of ocean residency. Because a high percentage of the spring Chinook salmon return to the Umatilla River are of hatchery origin and very few naturally produced fish have returned to TMFD, it is difficult to determine the age structure of the naturally-produced population in the Umatilla/Willow subbasin. However, the nearby John Day subbasin (which drains into the same Columbia River pool) has a naturally reproducing population of spring Chinook that can be used as a surrogate to reconstruct the likely age structure of the natural return to the Umatilla River. Wild spring Chinook salmon adults returning to the John Day are 81% age four (2 years ocean residency) and 16% age 5 (3 years ocean residency). “Jacks” make up three percent of the return and are of age 3 (1 year ocean residency).

In the Umatilla/Willow subbasin spawning begins in early to mid-August, peaks in late August/early September, and ends in late September (Figure 56). Juveniles emerge from the gravel in January and February (Kissner 2003).

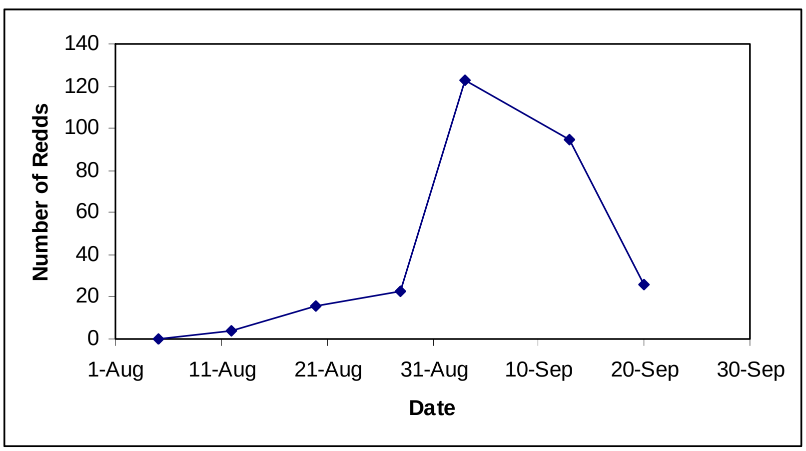


Figure 56. Timing of new spring Chinook redds in the Umatilla subbasin. Data from Kissner (2003).

Smolt outmigration from the subbasin begins in March, peaks in late March through late April, and is generally complete by late May (Figure 57). However, downstream movement of presmolts and smolts in the upper river begins in October and these individuals rear for 5 or 6 months in the middle mainstem (Figure 58).

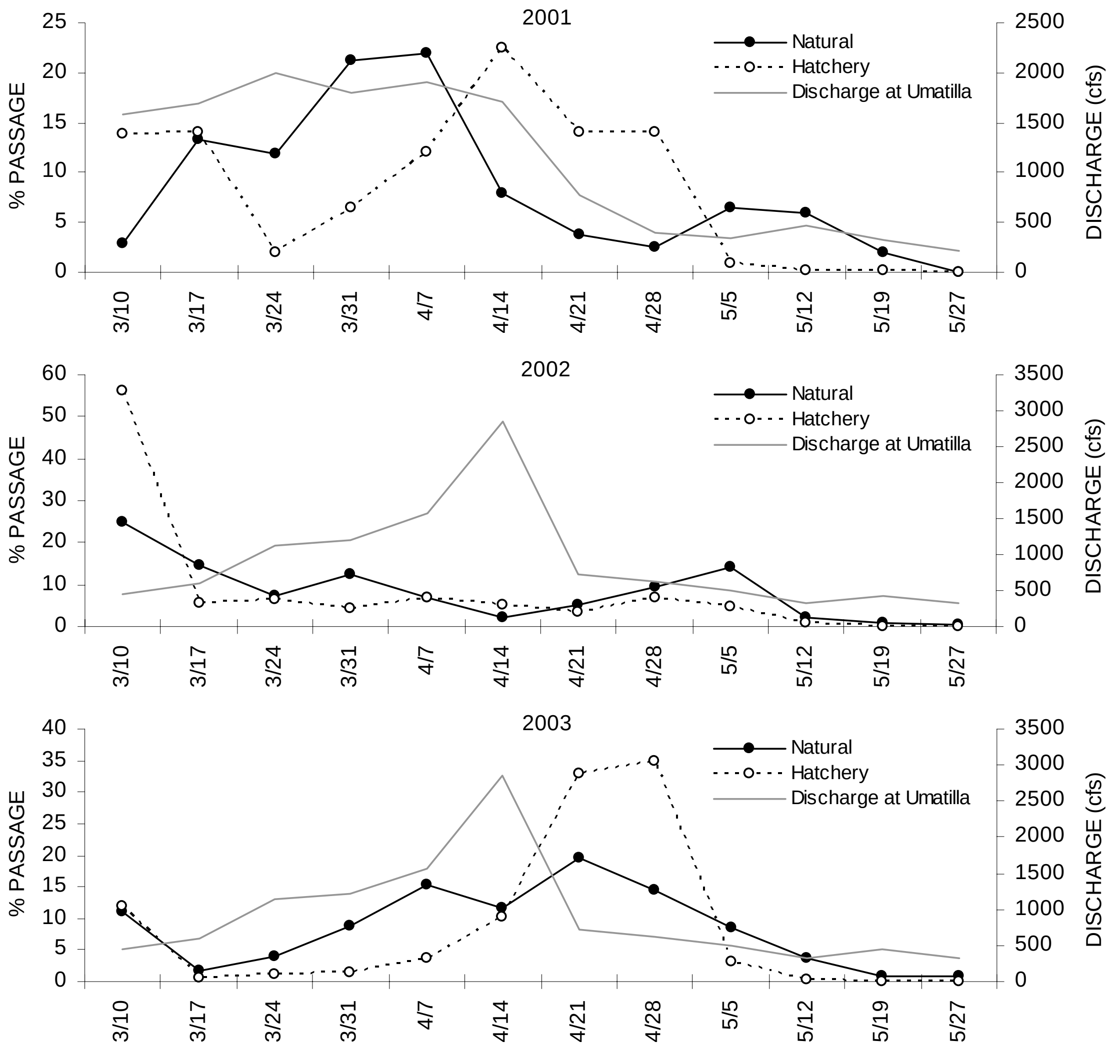


Figure 57. Migration timing of natural and hatchery spring Chinook smolts counted near the Umatilla River mouth during 2001, 2002, and 2003. The percentages were from weekly totals of fish divided by the respective total for the outmigration period. Daily Flow data at the lower Umatilla River gauge (RM 2.1) was averaged on a weekly interval. Figure from Chess et al. (2003).

Figure 58 summarizes the life history diversity of naturally produced spring Chinook within the subbasin associate with the timing of movement between tributaries and different areas of the mainstem. Most spawning occurs in the upper mainstem and upper tributaries as well as some spawning in the middle mainstem. Juvenile rearing occurs in the same areas; however, juveniles in the middle mainstem often move upstream in late spring and early summer as water temperatures rise in the middle mainstem. That fall pre-smolts begin to move downriver and can be found throughout the middle and lower mainstem.

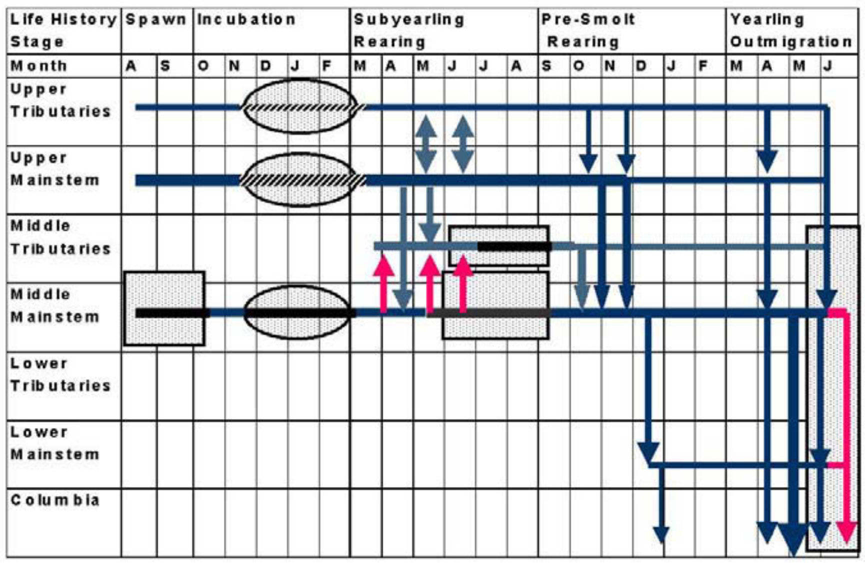


Figure 58. Life history chart of naturally produced Umatilla spring Chinook salmon; shaded ovals represent areas and times where redds are at risk from scouring and/or sedimentation during high flows; shaded rectangles and red arrows represent times and areas where high water temperatures may be limiting. Figure from Contor et al. (1998).

Genetic Diversity

The spring Chinook population in the subbasin is derived from the Carson Hatchery stock. This stock is a mixture of races of upriver spring Chinook that spawn above Bonneville Dam.

No work has been conducted on the genetic diversity of the Umatilla/Willow subbasin spring Chinook population.

Current and Historic Distribution

Most of the natural production of spring Chinook salmon in the Umatilla River occurs in the North Fork Umatilla and in the Umatilla mainstem from the Forks (RM 89.5) to the Bar M Ranch (RM 86) (Figure 59). Minimal production also occurs in Meacham Creek and the North Fork of Meacham. This restricted spawning range results from the high water temperatures that occur downstream of RM 86 during the spawning and early incubation season (mid-August to mid-October). Young-of-the-year have been observed at high densities for approximately 5 miles below the forks during biological surveys.

Older juveniles are more tolerant of higher water temperatures and are thus found rearing and overwintering in reaches of the middle mainstem and tributaries (Figure 58).

Little is known of historical spring Chinook salmon distribution in the Umatilla River Subbasin. However, oral testimony from tribal members and immigrants indicates that the North Fork Umatilla, McKay Creek above the reservoir, and the North Fork of Meacham Creek once had harvestable levels of spring Chinook salmon (Swindell 1942). In addition, spawning occurred in the mainstem from the forks (RM 89.5) to the confluence of McKay Creek (RM 50.5) and in McKay, Birch, and Butter creeks (Figure 10). It is unclear whether the Willow Creek subbasin historically had a spring Chinook population. A compilation of tribal fishing sites gathered from local tribal elders does not mention Willow Creek (Lane and Lane 1979); in addition, Willow Creek is not mentioned in a summary of salmonid distributions made by various fisheries agencies (Van Cleave and Ting 1960). This evidence suggests that the Willow Creek subbasin was not historically an important spawning or rearing area.

Spring Chinook salmon were extirpated from the Umatilla subbasin in the early 1900s as a result of a variety of human activities that led to channelization and loss of instream habitat, decreased instream water volume and increased water temperatures, and increased sediment input. These factors are covered in greater detail in the sections 3.1.1.9, 3.1.3.2, and 3.5.1. Currently, the reestablished returns of Carson stock spring Chinook salmon are threatened by many of the same anthropogenic impacts that drove the original population extinct. However, the most important factor currently limiting spring Chinook production and distribution is high water temperatures in the mainstem below RM 85.

Figure 59. Current and historic distribution of spawning habitat for spring Chinook in the Umatilla River subbasin.

Fall Chinook

Abundance and Population Trends

The total return of fall Chinook salmon to TMFD since the first adult return in 1988 has varied between 91 (in 1988) and 1,146 (in 2001) and averaged 493 adults. Annual return of jack fall Chinook salmon during this period varied between 29 and 1,158 and averaged 275 jacks (Figure 60). In 1995 the first naturally produced adults returned to TMFD. In 1996 no naturally-produced adults returned and in the following years there was some return, but in very low numbers (Figure 61). However, during this time hatchery adults have comprised the great proportion of the return. The estimated natural component of the adult return to TMFD from 1996-2003 has varied between 22 (in 1999) and 348 (in 2000) and averaged 158 naturally produced adults. As with steelhead and spring Chinook, between 1999 and 2001 an increasing number of adults have returned to TMFD and it is possible that this reflects a phase shift in the PDO to more favorable ocean conditions.

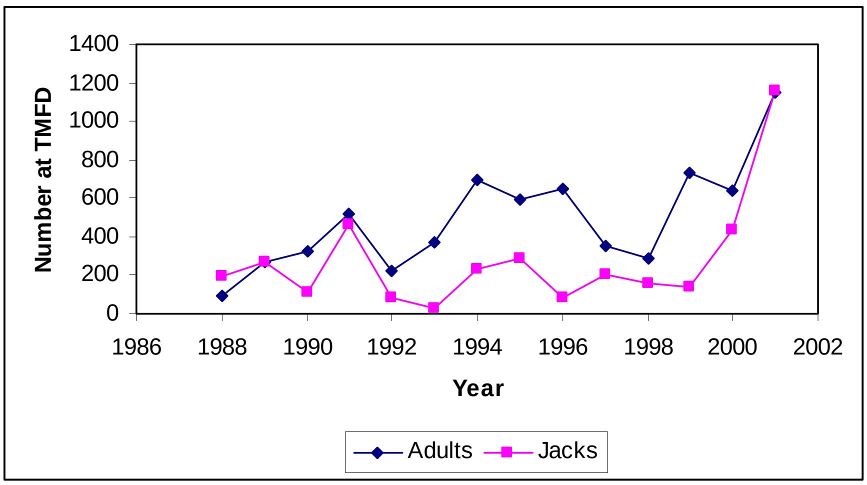


Figure 60. The total number of adult and Jack fall Chinook returns to TMFD from 1988 to 2001. Data from Chess et al. (2003).

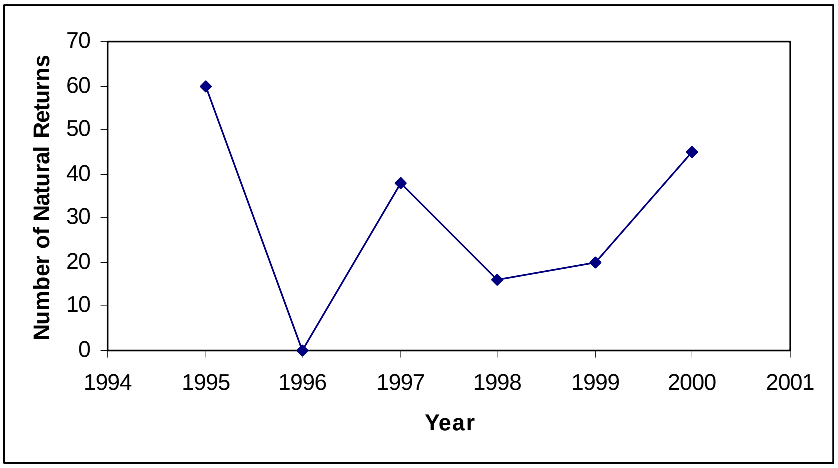


Figure 61. The number of naturally-produced adult fall Chinook returns to TMFD. Data from Chess et al. (2003).

Additional data on numbers of fall Chinook adults and jacks counted at TMFD, disposition, and escapement from 1988 to 2001 can be found in Table 3 of Appendix B.

Productivity

Female escapement and egg deposition: Data on female escapement above TMFD are shown in figure 62 for 1991 to 2000. Female escapement has been very low during this time with no obvious trends except for peak numbers in 1994 and 1995. In 1996 females from the Priest Rapids and Ringold Springs hatcheries were outplanted in the Umatilla River above TMFD to enhance productivity.

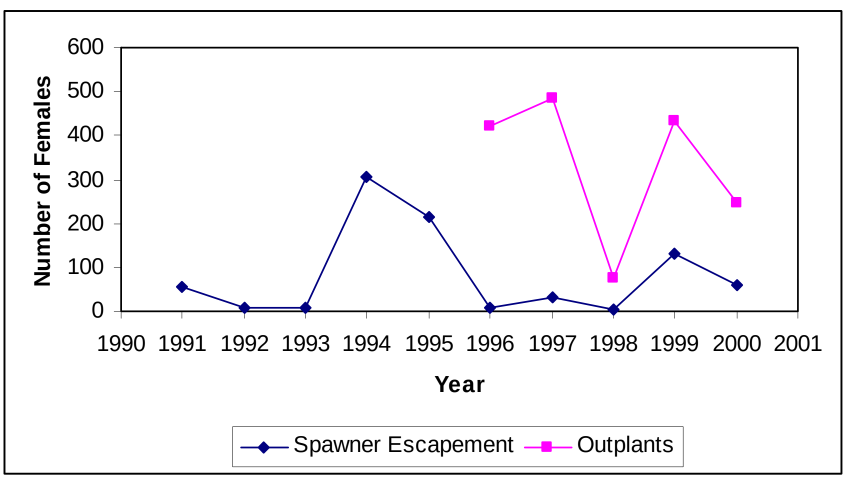


Figure 62. Female escapement above TMFD and the number of females outplanted above TMFD. Data from Chess et al. (2003).

The percent of spawning escapement that actually spawns was estimated by examination and dissection of carcasses to determine whether individuals were spawned out or had died before spawning (Kissner 2003). The surveys were conducted from 1991 to 2001 and reveal that a large percentage of fall Chinook adults spawn (Figure 63).

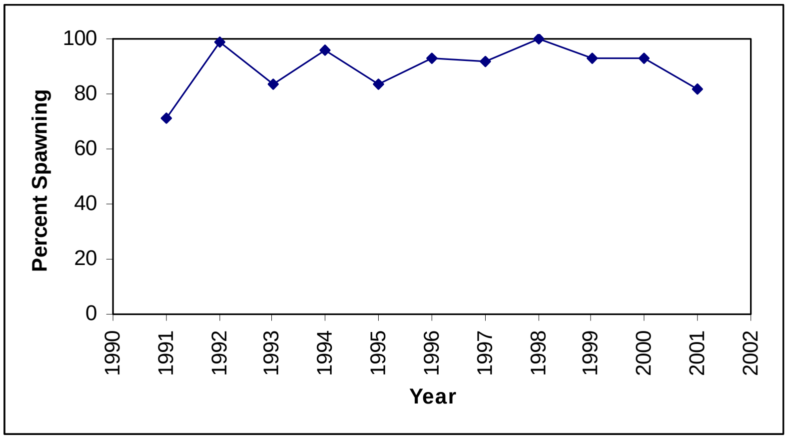


Figure 63. The percentage of carcasses that had spawned as an estimate of the percent of spawning escapement that actually spawns before dying. Figure modified from Kissner (2003).

Redd counts for fall Chinook are difficult for two reasons. First, fall Chinook spawn in the lower and middle Umatilla River mainstem (see Figure 71) in the same areas and at the same time as coho, making the identification to species of a redd difficult. In addition, there is much silt in the middle and lower mainstem, which, when disturbed, can obscure redds. Therefore, estimates of the number of eggs deposited have been made based upon female spawning escapement and the number of outplanted females (Figure 64). No obvious trends exist in egg deposition over this time. Very low numbers were estimated in 1998 as a result of both low spawner escapement and a small number of outplanted females during this year (Figure 62).

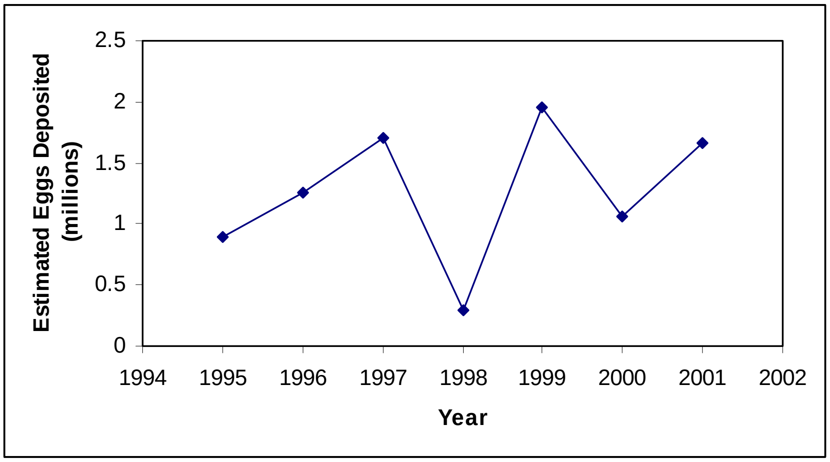


Figure 64. Estimated fall Chinook egg deposition based on female escapement (all years) and outplanted females (1996-2001 only). Figure modified from Kissner (2003).

Number of smolts and smolts per spawner: The numbers of fall Chinook smolts leaving the subbasin have been estimated since 1996 using traps near the mouth of the Umatilla River. Data are shown for the years 1996-2000 in Figure 65. In 1996 and 1998 the numbers were very low, below 1000. Only in 1997 were the number of smolts large, reaching almost one-quarter million; it is unclear as to why the numbers were so large that year.

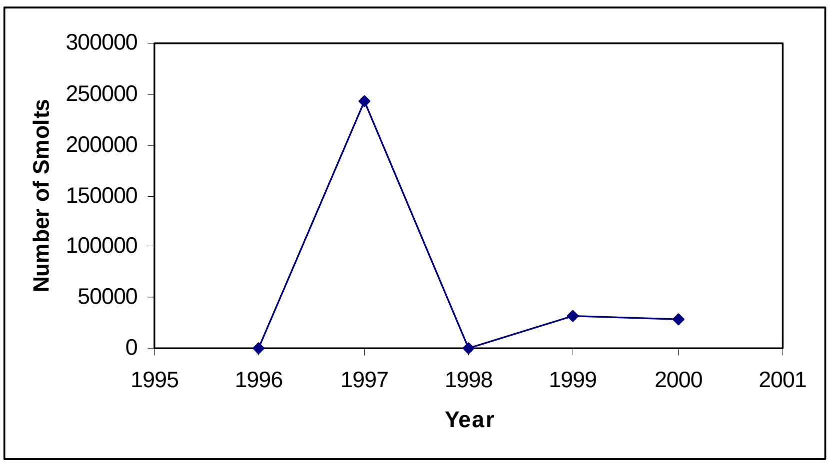


Figure 65. The estimated number of smolts leaving the Umatilla River based on numbers captured in traps near the river's mouth. Data from Chess et al. (2003).

The number of smolts per spawner shows a similar trend (Figure 66). A strong peak occurred in 1997, and very low numbers in all other years. These data do not suggest any trend in productivity for fall Chinook since 1996 when adults started to return to the subbasin.

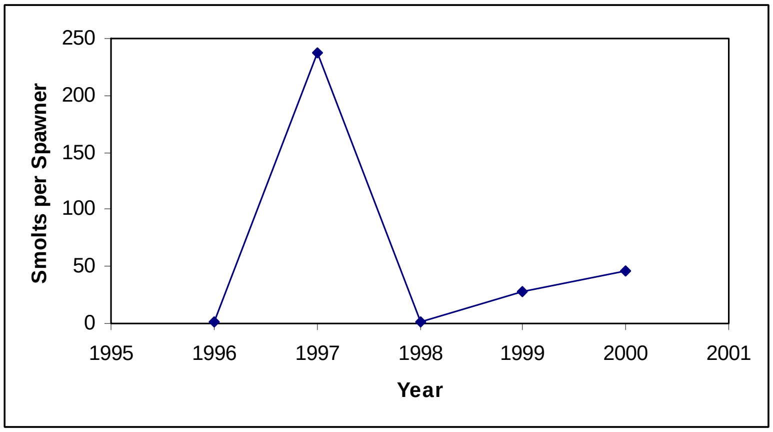


Figure 66. Estimates of the number of smolts produced per spawner. Data from Chess et al. (2003).

<u>Adult returns per number of spawners:</u> For fall Chinook this ratio was calculated as the number of adults returning to TMFD for a given brood year by the total number of adults available to spawn (i.e., spawning escapement at TMFD and in 1996 outplanted females). Data exist to calculate this ratio for only three years (Figure 67). For each of these years, the value of this measure of productivity was well below 1 (the value that indicates replacement of the population). This was true even in 1996 when over 400 females were outplanted above TMFD to supplement the spawning escapement.

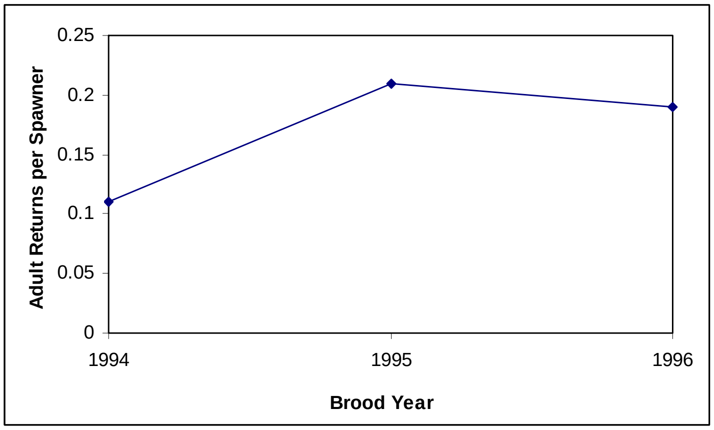


Figure 67. Estimates of the number of adult returns per number of adults spawning for a given brood year. Data from Chess et al. (2003).

All three estimates of productivity indicate that fall Chinook productivity is very low in the subbasin. Developing an understanding of the low level of smolt production and returns is an important issue. The most likely factors influencing productivity of fall Chinook are discussed below under *Current and Historic Distribution.*

Life History

The endemic fall Chinook stock was extirpated from the subbasin in the early 1900s. In 1982 fall Chinook were reintroduced into the subbasin with Tule stock and then starting in 1983 with Upriver Bright stock (Evans 1984).

Fall Chinook spend from two to six years in the ocean; however, no data is available for the age structure of adults returning to the Umatilla/Willow subbasin. Juvenile fall Chinook spend only three to four months in the subbasin before outmigrating as subyearling smolts (Figure 70).

Adults return to the Umatilla River from August through December. Spawning occurs in the lower and middle sections of the mainstem Umatilla River from early November to mid-December (Figure 68). Juveniles emerge from the gravel in April and subyearlings begin to outmigrate in May. The timing of peak outmigration varies from year to year and between natural and hatchery smolts. However, the peak generally occurs between late May and early July and outmigration ends by mid-July (Figure 69).

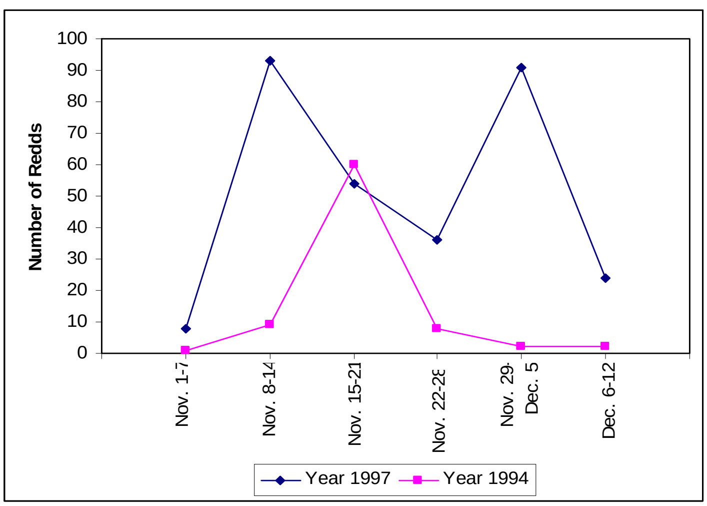


Figure 68. Timing of spawning based upon counts of new fall Chinook redds in the Umatilla River. Data from Kissner (2003).

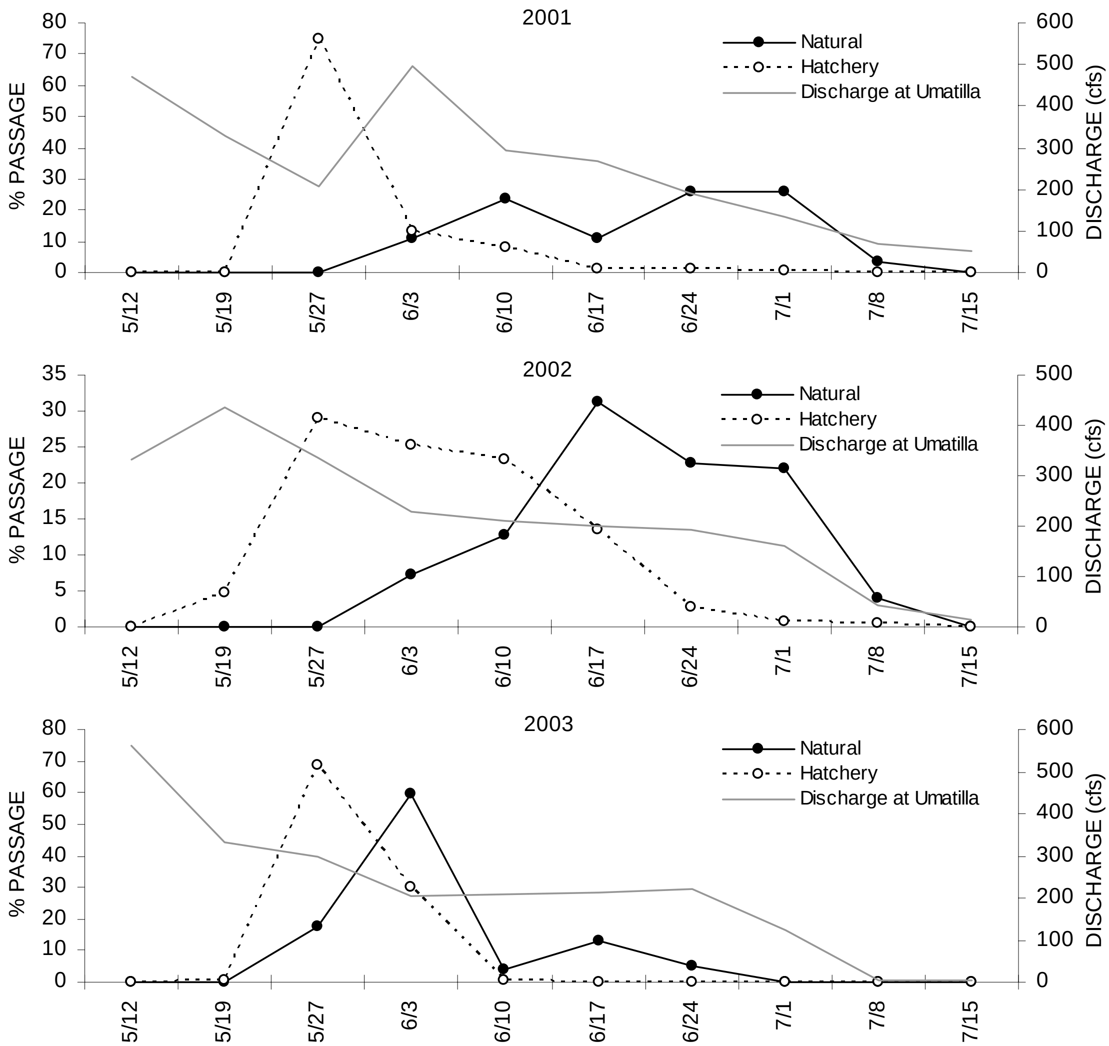


Figure 69. Migration timing of natural and hatchery fall Chinook smolts counted near the Umatilla River mouth during 2001, 2002, and 2003. The percentages were from weekly totals of fish divided by the respective total for the outmigration period. Daily Flow data at the lower Umatilla River gauge (RM 2.1) was averaged on a weekly interval. Data provided by ODFW, May, 2004.

Naturally produced fall Chinook have the most restricted use of the subbasin of all the anadromous focal species (Figure 70). Adults spawn in the mainstems below RM 50.5 and juveniles rear in these same areas before outmigration. Occassionally, fall Chinook redds have been found farther upstream; in 1998 4 redds were found in Buckaroo Creek (a tributary to the mainstem that enters the Umatilla River at RM 70) and in 1999 fall Chinook redds were observed in the mainstem up to RM 67. Use of tributaries is minimal at all life stages.

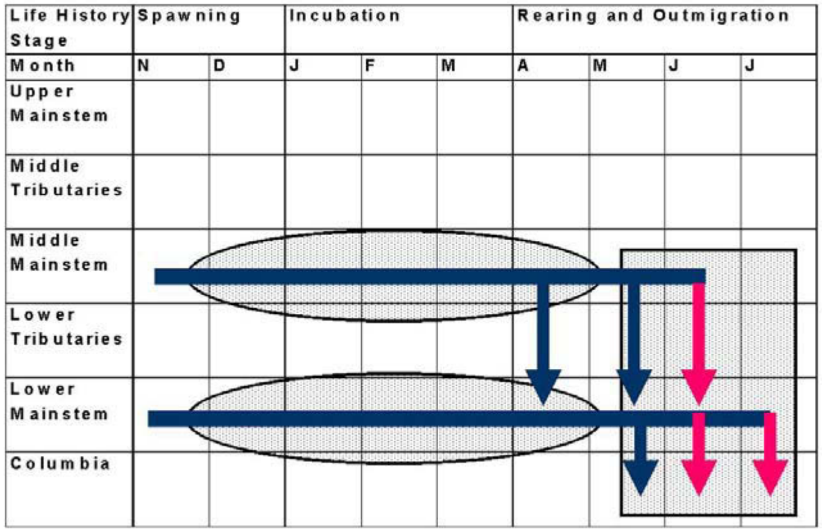


Figure 70. Life history chart of naturally produced Umatilla fall Chinook salmon; shaded ovals represent areas and times where redds are at risk from scouring and/or sedimentation during high flows; shaded rectangles and red arrows represent times and areas where high water temperatures may be limiting. Figure from Contor et al. (1998).

Genetic Diversity

The endemic stock of fall Chinook in the subbasin was extirpated in the early 1900s. In 1982 fall Chinook were reintroduced using Tule stock and then in 1983 with Upriver Bright stock. No measurements of genetic diversity have been made of the population in the subbasin.

Current and Historic Distribution

The current distribution of fall Chinook spawning adults and rearing juveniles is shown in figure 71. Historically, fall Chinook were found in the Umatilla/Willow subbasin. However, the historic distribution of fall Chinook in the subbasin is unknown because traditionally fall and spring Chinook were recognized as one species and it is unclear where divisions between their spawning habitat occurred.

Fall Chinook salmon were extirpated from the Umatilla subbasin in the early 1900s as a result of a variety of human activities including habitat destruction, high water temperatures, and reduced flows. Another factor that might have played a larger role in the extinction of fall Chinook in the subbasin than it did for steelhead or spring Chinook was the construction and operation of Three Mile Falls Dam in 1914. This dam would have blocked or greatly impeded access to the river during low flow periods, late summer and early fall when fall Chinook are returning to the subbasin (BOR 1988).

Currently, the reestablished returns of Upriver Bright stock fall Chinook salmon are threatened by many of the same anthropogenic impacts that most likely drove the original population extinct. For fall Chinook perhaps the most important factors that currently limit productivity and may have led to extinction of the original population are: high levels of sediment, which reduces egg survival; high scouring flows, which increase egg and juvenile mortality, and high summer water temperatures, which increase outmigrating smolt mortality (Chess et al. 2003). Interestingly, releases of cold water from McKay reservoir might also limit the current productivity and distribution of fall Chinook. An early analysis of the Umatilla River and its suitability for fall Chinook spawning suggested that the great majority of spawning habitat was above Pendleton (RM 55) (Boyce 1986). However, few fall Chinook spawn above Pendleton, and it is possible that releases from McKay reservoir have created a thermal barrier (cool water below McKay confluence, RM 50.5, and warm water above it) beyond which few fall Chinook pass (Chess et al. 2003).

The factors limiting the distribution and abundance of fall Chinook are covered in greater detail in the sections 3.1.1.9, 3.1.3.2, and 3.5.1.

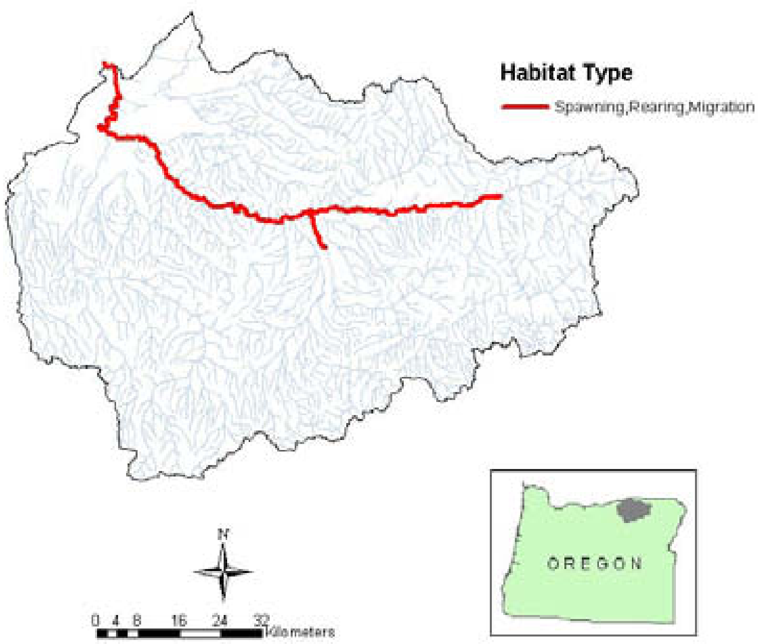


Figure 71. Current fall Chinook habitat use in the Umatilla River.

Coho

Abundance and Population Trends

Coho jack and adult returns to TMFD have been enumerated since 1988. From 1988 to 2003 adult returns have varied widely from 356 (in 1992) and 22,792 (in 2001) and averaged 3,669 adults (Figure 72). Jack numbers have also varied during this time from 16 (in 1993) to 1,276 (in 2000) and averaged 361 jacks (Figure 72). Because of the high costs of marking hatchery fish, only a small proportion of hatchery released coho are marked and therefore a separation of the number of hatchery produced vs. naturally produced returning adults is not available. As with the other focal species, coho returns to TMFD have been large from 1999 to 2003 (average adult returns during the four years from 1999 to 2003 was 8,657 as compared to the average of 3,669 adults during the entire period from 1988 to 2003), suggesting a possible response to the PDO phase shift.

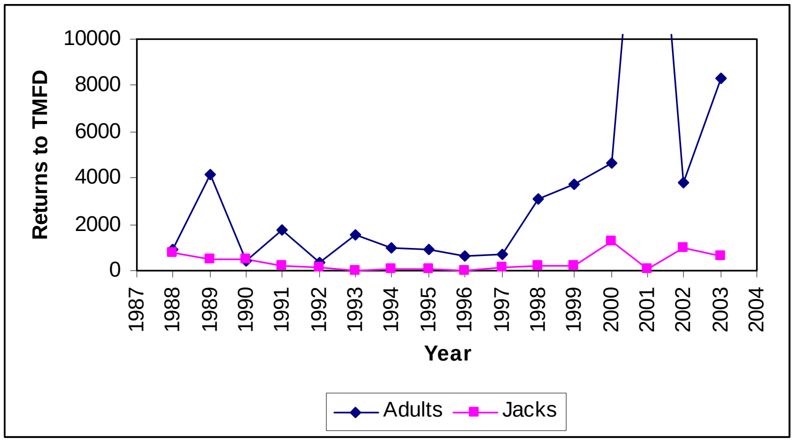


Figure 72. Number of adult and jack coho counted at TMFD from 1988 to 2003. In 2001 the number of adults counted was 22,729. Data provided by CTUIR, DNR, Fisheries Program.

Additional data on numbers of coho adults and jacks counted at TMFD, disposition, and escapement from 1988 to 2003 can be found in Table 4 of Appendix B.

Productivity

Little data exist on the productivity of the coho population in the Umatilla/Willow subbasin. Coho spawn in the mainstem Umatilla River from the mouth to just above the Meacham Creek confluence (RM 79), with the majority of the spawning occurring between RM 25 to RM 79 (Contor 2003; Contor et al. 1997, 1998, 2000). In much of this region high flows that scour redds and fine sediment that covers eggs can be significant risks to egg survival. The actual risk to redds is unclear; however, natural production is considered to be very low (Kissner 2003). The only data on productivity is spawning escapement and the potential number of eggs deposited, these are summarized below.

Total spawning escapement at TMFD has varied greatly between 1988 and 2003 (Figure 73), following the trends in total adult returns. The lowest escapement was 105 (in 1995) and the highest was 22,513 (in 2001) with an average of 3,216 adults available for spawning.

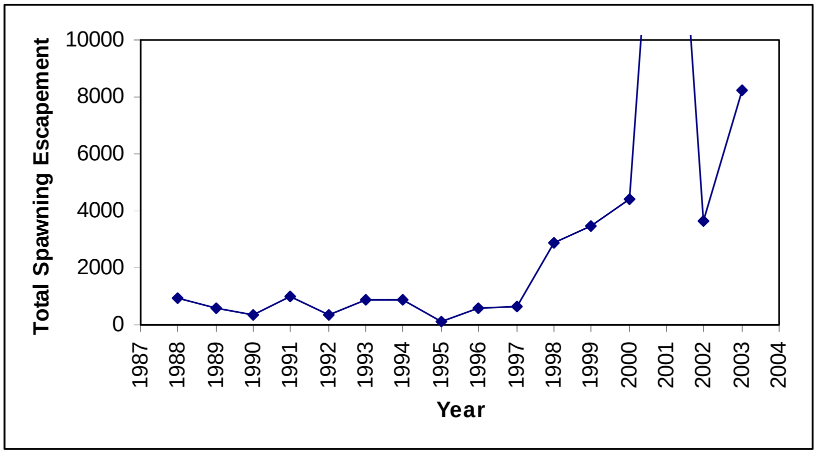


Figure 73. Total spawning escapement at TMFD from 1988 to 2003. In 2001 the spawning escapement was 22,513. Data provided by CTUIR, DNR, Fisheries Program.

Based on carcass surveys conducted by the CTUIR, the proportion of the escapement surviving to spawn is high, particularly between the years 1994 and 2001 when over 88% of carcasses surveyed each year had spawned (Figure 74).

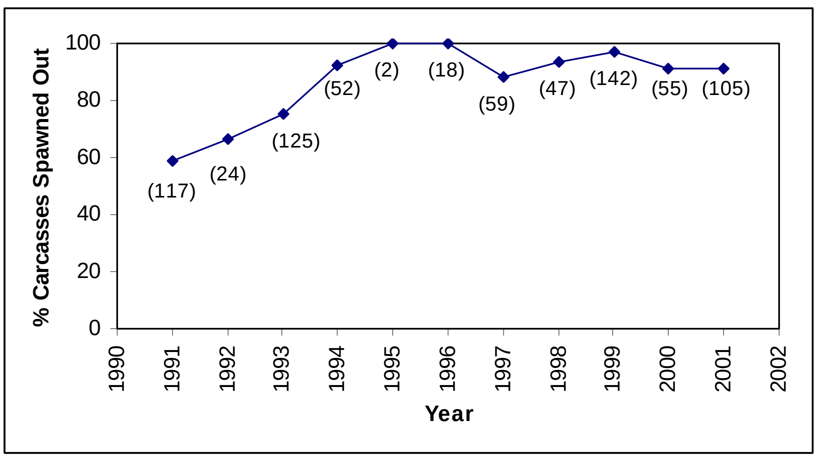


Figure 74. The percentage of all coho adult carcasses found during surveys that had spawned. Numbers in parentheses below data points are the total number of carcasses examined for that year. Data provided by CTUIR, DNR, Fisheries Program.

As with fall Chinook, redd counts for coho are difficult for two reasons. First, the spawning distributions and seasons of coho and fall Chinook overlap making the identification of redds to species difficult. Second, there is much silt in the middle and lower mainstem, which when disturbed can obscure redds, making redd counts difficult. Therefore, estimates of the number of eggs deposited have been made based upon female spawning escapement (Figure 75) (Kissner 2003). The trends in egg deposition follow those in total escapement, with increasing numbers from 1998 through 2000 and exceptionally high numbers in 2001 as a result of a very large number of returning adults in that year.

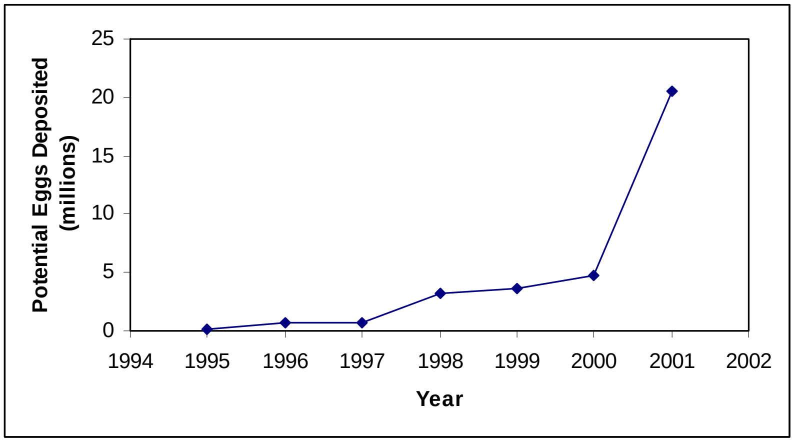


Figure 75. An estimate of the number of coho eggs deposited from 1995 to 2001 based on spawner escapement. Figure modified from Kissner (2003).

Life History

As with Chinook salmon, coho went extinct in the Umatilla/Willow subbasin early in the 20th century. From 1966 to 1969 and then starting again in 1987 hatchery reared coho smolts have been introduced into the Umatilla River. These smolts are from Tanner Creek stock.

Adult coho salmon returning to the Umatilla River typically enter the river from mid-September through mid-December (Figure 76) (Contor et al. 1997). Most returns are adults but three year olds (jacks) are common and have averaged about 9% of the total returns since 1988.

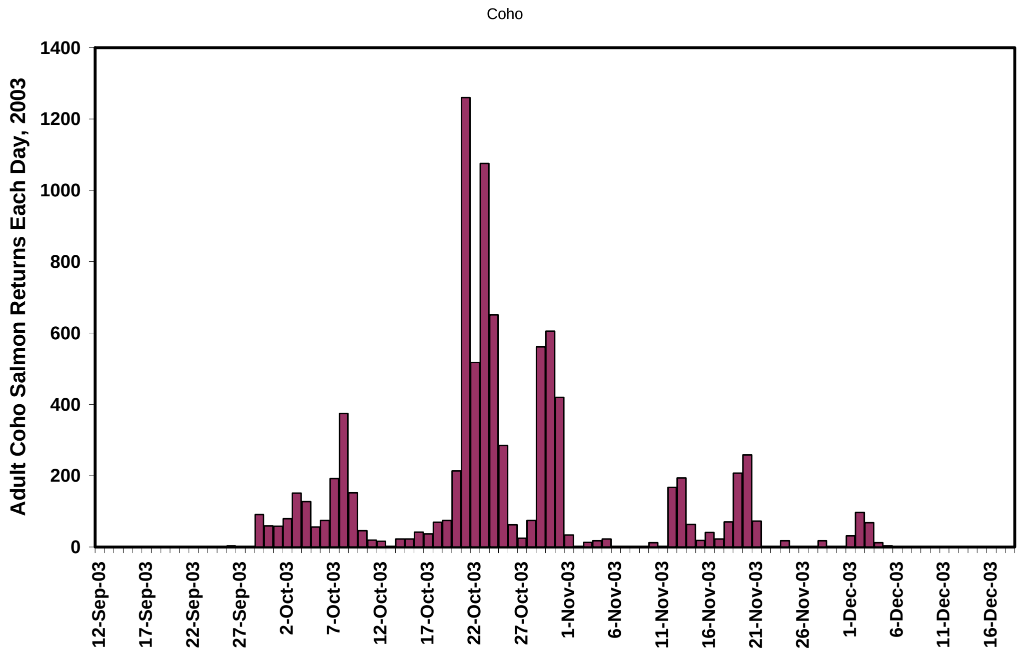


Figure 76. Return timing of coho salmon to the Umatilla River, 2003. Data provided by P. Bronson, CTUIR Passage Biologist, May, 2004.

Spawning has been observed in late October and throughout November and December with a few observations made in January (personal communication: C. Contor, CTUIR, May 2004).

Coho emerge from the gravel in February, March or April depending on the location of the redds in the winter and the associated water temperature and spawn time. Most juvenile coho rear one summer and one winter in the Umatilla before migrating to the Columbia River in April and May (Figure 77).

Extensive surveys of coho smolt outmigration have not been conducted. However, CTUIR and ODFW staff PIT tagged naturally produced juvenile coho in the fall and spring of 2000 and 2001 prior to their outmigration and found that most migrate out of the basin in April and May and are detected in the lower Columbia River dams during April, May and June. Detection rates of PIT tagged coho have been low and the survival estimates for outmigration natural coho salmon are not robust but have been in the 15%-20% range (Contor 2003).

The spatial distribution by life history stage of coho salmon in the Umatilla River subbasin is shown in Figure 77. Coho primarily use the mainstem with only some use of the middle tributaries during their first summer of rearing as mainstem temperatures increase (Figure 77).

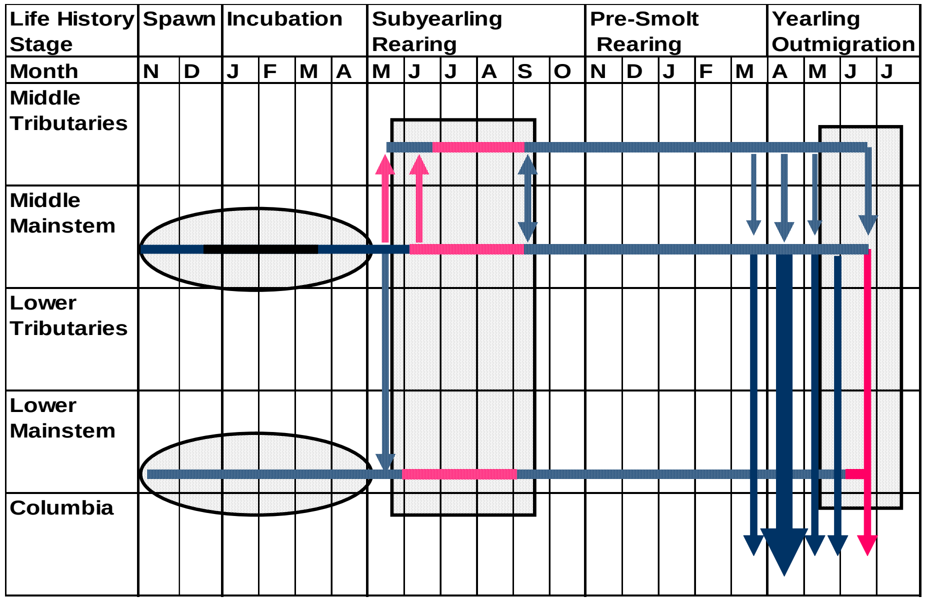


Figure 77. Life history schematic for Umatilla River coho salmon. Shaded ovals represent times where there is occasionally risk to redds from either scour or fine sediment deposition. Shaded rectangles and red arrows represent a risk to fry or parr from elevated water temperatures. Figure from Contor et al. (1998).

Genetic Diversity

Genetic diversity of coho salmon released into the Umatilla River has not been evaluated locally. There is not a local broodstock source for coho and smolts released into the Umatilla River are the progeny of hatchery adults collected in Tanner Creek near Bonneville Hatchery. While recommended by Watson (1996), there has not been a genetic monitoring and evaluation program for the Bonneville Hatchery Coho Salmon Program. However, coho genetics has been examined on a broader scale. Currens et al. (2004) reported that the “heterogeneity among coastal populations was much greater than among lower Columbia River populations” where the Tanner stock comes from. Moran and Bermingham (2004) reported that coho salmon collected from Bonneville Hatchery appeared to be genetically distinct from other populations in the Pacific Northwest.

Current and Historic Distribution

The current distribution of coho salmon is limited to the Umatilla River subbasin; coho are not found in the Willow Creek subbasin. Naturally produced juvenile coho have been found from the mouth of the Umatilla River mainstem to near the North and South Forks (Figure 18). A limited number have been found in Meacham Creek and large numbers have been found in McKay Creek below McKay Dam (Figure 78).

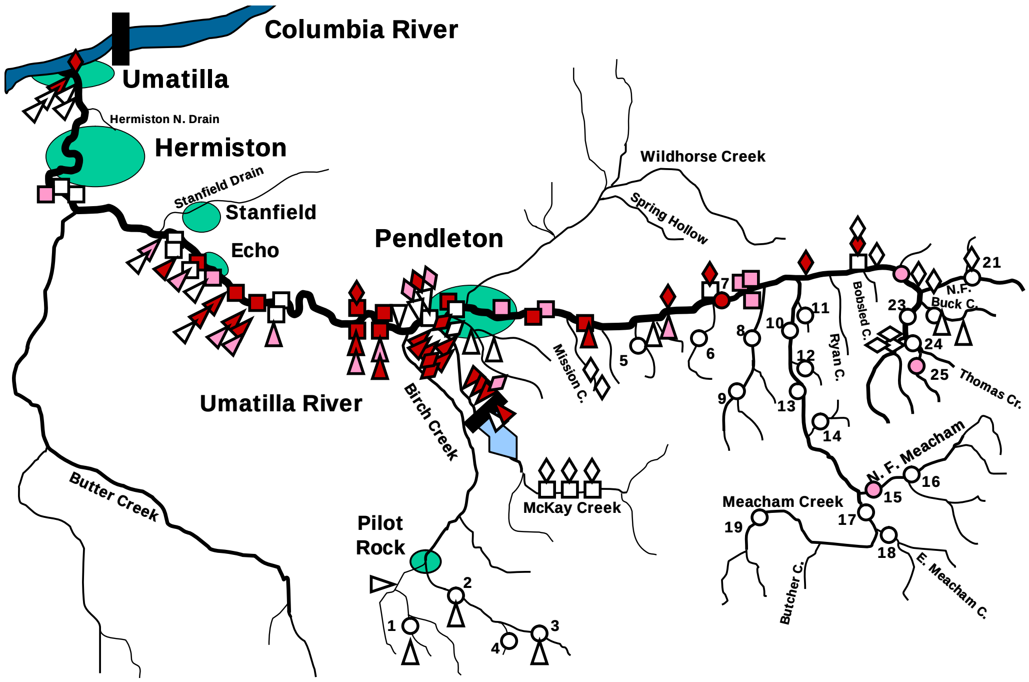


Figure 78. Summary of juvenile coho salmon collected from the Umatilla River Basin, 1999-2002. Circles represent index sites (1999-2002). Squares, triangles and diamonds represent presence absence surveys conducted during 1999, 2000 and 2001 respectively. Dark symbols denote moderate to high numbers. Lightly colored symbols represent low numbers. Juvenile coho were not captured at locations denoted by white symbols. Figure from Contor (2003).

The current spawning distribution is more limited than the distribution of rearing juveniles. Spawning has been observed only in the mainstem Umatilla River from the mouth to just above the Meacham Creek confluence (RM 79), with the majority of the spawning occurring between RM 25 to RM 79 (Figure 79) (Contor 2003; Contor et al. 1997, 1998, 2000).

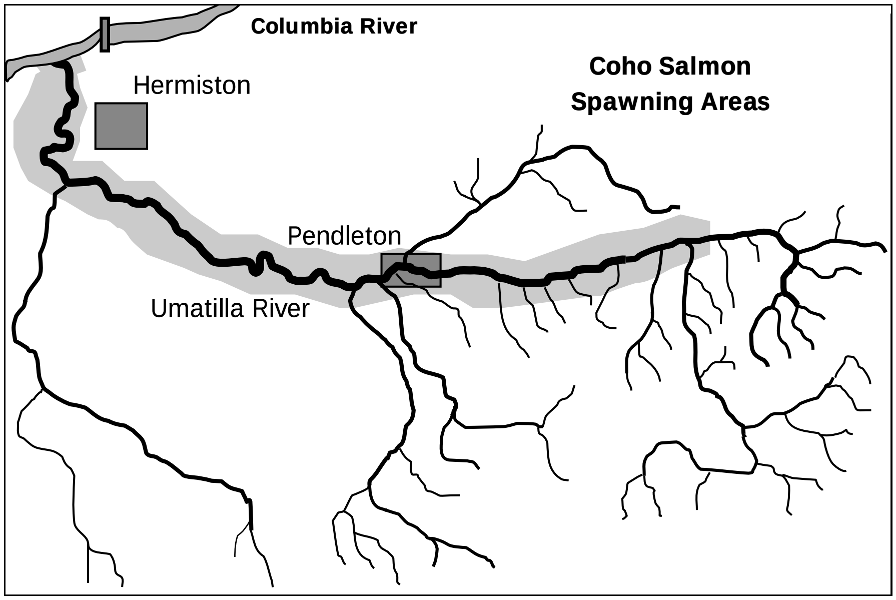


Figure 79. Coho spawning distribution in the Umatilla River Drainage (1989-2003). Figure from CTUIR, DNR, Fisheries Program.

The historic distribution of coho in the Umatilla/Willow subbasin is unclear. Records specifically stating that coho were in the Umatilla River or Willow Creek are not available. The historical distribution of coho salmon in Oregon included many tributaries of the lower and mid Columbia and Snake Rivers as well as most coastal basins (Johnson et al. 1991). Van Cleve and Ting (1960) found historical references stating that "salmon returned to the Umatilla River from spring through fall." Fall Chinook and coho salmon would be the only candidates for salmon returning in the fall. Given that coho were documented in many of the tributaries of the lower and mid Columbia and Snake Rivers, it is reasonable to expect that coho were present in the Umatilla River.

As with steelhead and Chinook, coho salmon were extirpated from the Umatilla subbasin in the early 1900s as a result of a variety of human activities including habitat destruction, high water temperatures, and reduced flows. As with fall Chinook, the construction and operation of Three Mile Falls Dam in 1914 probably played a large role in the extinction of coho from the subbasin as it would have blocked or greatly impeded access to the subbasin during the late summer and fall when coho adults return (BOR 1988).

The factors limiting the distribution and abundance of coho are covered in greater detail in the sections 3.1.1.9, 3.1.3.2, and 3.5.1.

3.2.3.2 Taxa of Interest -- Population Data, Life History, and Distribution

Pacific Lamprey

Abundance and Population Trends
Larval abundance in the Umatilla/Willow subbasin have been estimated since 1998. Densities in 1998 were very low, of 42 index sites surveyed, larval lamprey were collected at only 4 and the densities ranged from 0.001/m^2 to 0 0.005/m^2 (Close and Jackson 2000). In 2000, 30 index sites were surveyed and again larvae were only collected at 4 sites found between RM 2.5 and 22.9 (the survey was conducted up to RM 79.8). Densities of larvae found in 2000 were much higher than they had been in 1998 and ranged between 0.13 and 1.66 individuals per m^2 (Close et al. 2002). In 2000 an adult outplanting program was started which appears to have increased the productivity of the lamprey population in the Umatilla/Willow subbasin. Adults were captured from the John Day subbasin and outplanted in the upper Umatilla River mainstem (RM 61.4 to 87.1) and Meacham Creek. This appears to have been successful in increasing the abundance of larval lamprey. Estimates of larval abundance at 34 index sites in 2002 found high abundances at index sites in Meacham Creek and in the Umatilla River mainstem above RM 63.5. At these sites larval density averaged 18.0 ± 1.9 (standard deviations) individuals per m^2 (Aronsuu et al. 2003). Below RM 63.5 only a few larvae were found as in previous years at 4 of 19 sites.

The abundance of potential outmigrating lamprey was measured with rotary screw traps near the mouth of the Umatilla River in 2000 and 2002. In 2000 trapping took place from 9/1/99 to 3/9/00 and a total of 133 metamorphosed lamprey and 363 larvae were collected (Close et al. 2002). In 2002 trapping took place 10/31/01 to 03/09/02 and a total of only 25 metamorphosed and 58 larval lampreys were collected (Aronsuu et al. 2003). Based on this limited data, it is difficult to make any statements about changes in outmigrant abundance.

Productivity
Productivity of the Umatilla/Willow subbasin lamprey population is very low. In 1998 only 5 adults were observed at TMFD (Close and Jackson 2000). In the fall of 1999 through spring of 2000 only 3 adults were captured near the mouth of the Umatilla River (Close et al. 2002). Finally, in 2002 no returning adults were trapped near the mouth of the river even though over 26,000 and over 11,000 adults were counted at the John Day and McNary dams, respectively (Aronsuu et al. 2003). The absence of any adults observed migrating into the Umatilla River is thought to be the result of extremely low discharge from the Umatilla River into the John Day pool during the time of peak adult migration (late July through September) (Aronsuu et al. 2003).

To increase productivity of the Umatilla population, adults captured in the John Day River have been outplanted into the Umatilla River mainstem and Meacham Creek since 2000 (personal communication: A. Jackson, CTUIR, April, 2004). A summary of the numbers and locations of outplanted adults is presented below in section 3.2.3.3.

Evidence from larval surveys suggests that outplanting is successful in terms of greatly increasing the number of larvae within the subbasin. Prior to outplanting no larvae were observed above RM 22.9. Two years after outplanting high larval densities were observed throughout the areas in which adults were released. The impact of the year 2000 outplanting on outmigration of metamorphosed lamprey will not be evident until 2004 at the earliest as Pacific lamprey juveniles spend 4 to 6 years in freshwater (Kan 1975; Richards 1980).

The productivity of the lamprey population can also be examined through nest counts. Nest counts were conducted in sections of the upper Umatilla River, North and South forks of the Umatilla River, and in Meacham Creek. In 2000 a total of 81 nests were found, 51 in the upper Umatilla mainstem and 30 in Meacham Creek (Close et al. 2002). In 2002 a total of 67 nests were counted, 21 in the upper Umatilla mainstem and 46 in Meacham Creek (Aronsuu et al. 2003). Too little data exists at this time to make any statements about trends in productivity based on nest surveys. However, the nest surveys do provide important information about suitable nesting habitat.

Life History

The life history of Pacific lamprey is complex and involves a larval stage, metamorphic outmigrant stage, marine parasitic stage, and a spawning migration. Pacific lamprey exhibit a protracted freshwater juvenile residence in the stream benthos. Larvae, often referred to as ammocoetes, leave the nest approximately two or three weeks after hatching, drift downstream (usually at night), and settle in slow depositional areas such as pools and eddies (Pletcher 1963). The larvae then burrow into the soft sediments in the shallow areas along the stream banks (Richards 1980). The larval stage has been estimated to range from 4-6 years (Pletcher 1963; Kan 1975; Richards 1980) although it may extend up to 7 years (Hammond 1979; Beamish and Northcote 1989). It is not clear how long the larval stage is in the Umatilla/Willow subbasin.

From July through November larvae undergo metamorphosis in which morphological and physiological changes prepare the individuals for a parasitic lifestyle in salt water (Pletcher 1963; Richards and Beamish 1981). Young adult lampreys generally begin their migration to the Pacific Ocean in the fall and continue through the spring. In the Umatilla River outmigration of metamorphosed lamprey was observed in early November in 1999 and 2001 and continued as late as March in 2000; during both outmigrant periods peak numbers were observed in December (Close et al. 2002; Aronsuu et al. 2003).

The ocean life history stage of Pacific lamprey is not well understood, but the duration of ocean residency may vary. The parasitic-phase has been estimated to last for periods of up to 3.5 years for Pacific lamprey in the Strait of Georgia, British Columbia (Beamish 1980). Off the coast of Oregon, the duration of the ocean phase was estimated to range from 20 to 40 months (Kan 1975). Parasitic-phase Pacific lamprey have been collected at distances ranging from 10 to 100 km off the Pacific coast and at depths ranging from 100 to 800 m (Kan 1975; Beamish 1980).

The Pacific lamprey preys on a variety of fish species and marine mammals in the Pacific Ocean. Beamish (1980) reported five salmonid and nine other fish species that are known prey of Pacific lamprey (Table 1). Pacific lamprey has been reported to feed on finback, humpback, sei, and sperm whales (Pike 1951). In addition, feeding occurs on a variety of midwater species such as Pacific hake and walleye pollock in the open ocean (Beamish 1980).

Beamish (1980) suggested that returning adult lampreys enter fresh water between April and June and complete migration into streams by September. Pacific lamprey overwinter in fresh water and spawn the following spring (Beamish 1980). Pacific lamprey does not feed during the spawning migration. They utilize stored carbohydrates, lipids, and proteins for energy (Read 1968). Beamish (1980) observed a 20% shrinkage in body size from the time of freshwater entry to spawning. Pacific lamprey along the coast of Oregon usually begin to spawn in May when water temperatures reach 10°C to 15°C and continue to spawn through July. In the Umatilla/Willow subbasin adults were observed spawning in Meacham Creek in 2002 from the 28^{th} of May until the 13^{th} of June (Aronsuu et al. 2003). Adults die within 3 to 36 days after spawning (Kan 1975).

Current and Historic Distribution

Pacific lamprey larvae are currently found both in the lower Umatilla River mainstem and in the upper mainstem. As stated above, abundances in the lower mainstem are very low and the high abundances in the upper mainstem are most likely the result of outplanting of adult John Day lamprey. In addition to the mainstem, lamprey are also currently found in Meacham Creek, also most likely as a result of the outplanting of adults. Surveys have not been conducted in Willow Creek and its tributaries; however, the passage problems found in Willow Creek most likely preclude any adult lamprey from migrating up Willow Creek to spawn.

Information on the historic distribution of lamprey within the subbasin comes from interviews conducted by CTUIR staff with 12 tribal elders between 1996 and 1999 (Close and Jackson 2001). Results from these interviews reveal that historically lamprey were found in the Umatilla River mainstem from the mouth to the headwaters and harvest occurred from spring through fall (Close and Jackson 2001). No mention is made of lamprey occurring in Willow Creek and its tributaries in these interviews (Close and Jackson 2001) and thus it is unclear whether they occurred historically in this area.

The decline in the distribution of lamprey in the Umatilla/Willow subbasin has been attributed to many of the same factors that have resulted in the decline of anadromous salmon and steelhead populations and include poor habitat, water pollution, passage over dams, and ocean conditions (Close et al. 1995). In addition, another factor that might have contributed greatly to the decline of lamprey in the subbasin was the chemical treatment of the Umatilla River with rotenone in 1967 and 1974 (Close et al. 1995).

Mussels

Current and Historic Abundance and Distribution

Abundance estimates of mussels are most easily made on adults, which are sedentary and thus estimates of abundance and distribution are tightly linked and are presented together here. The following information on the current distribution comes from J. Brim Box (CTUIR, personal communication, April 2004):

> Freshwater mussels have been extirpated from most of the main stem of the Umatilla River and possibly tributaries. Shell evidence and historical records via interviews with tribal elders suggest that mussels were once found in the main stem of the Umatilla River, at least as far upstream as above Mission, but now are confined to a few sites near its confluence. Based on the results of an inventory conducted in 2003, mussels were rare in the main stem and tributaries of the Umatilla River. Mussels were found at only six of the 55 total sites sampled. Only two genera, *Anodonta* and *Gonidea*, were found in the basin. No live *Margaritifera falcata* were found, although at one upstream site numerous shells and fragments were scattered within the river and around the floodplain. In addition, no mussel beds were found on in the Umatilla River, and the maximum number of mussels counted at one site was 52 *Anodonta*. Although *Anodonta* were more abundant at this site than at other sites in the Umatilla River, they were too dispersed to sample quantitatively.

Information on the historical distribution of mussels in the Umatilla/Willow subbasin also comes from J. Brim Box (CTUIR, personal communication, April 2004):

> Historical Data Collection
> Ninety-seven records of historical mussel occurrences in Oregon were obtained, dating back to 1838, from the US Forest Service Freshwater Mollusk Database. Of these records, only two do not list a specific drainage. Accounts from the Columbia River drainage comprise about a third of these records. These records from the Columbia Basin include five of the eight species known to currently occur in the western United States: *Anodonta beringiana, Anodonta nuttalliana, Anodonta oregonensis, Gonidea angulata* and *Margaritifera falcata.* No records were found from the Umatilla River or its tributaries.
>
> Museum Collections
> A total of 81 historical records of freshwater mussels from the western United States (i.e., shell material reposited in museum collections) were found at the United States National Museum (Smithsonian Institution) and California Academy of Sciences. Over half of these records of freshwater mussels were from the Columbia River drainage. However, none was from the Umatilla River or its tributaries.
>
> Interviews
> Although no museum or historical records for freshwater mussels were found from the Umatilla River, tribal elders who were interviewed remembered gathering mollusks at the mouth of the Umatilla and Walla Walla rivers and at the mouth of Squaw Creek. One tribal member

> commented, "at one time mussels were plentiful in all tributaries and bigger mussels were found in the main stem of the Umatilla River" (A. Minthorn, pers. com., 2003, CTUIR tribal member). In the mid 1940s, freshwater mussel shells were observed scattered along the banks of the Umatilla River from river kilometer 107 to river kilometer 99 (Bernadette Nez, per comm., 2003, CTUIR tribal member).

The interviews suggest that historically mussels were abundant throughout the Umatilla River subbasin; however, no mention was made of Willow Creek and its tributaries so it is unclear whether that area had mussels historically and if so, in what abundance. The cause of the change in distribution from historic to current times is unclear. However, mussels are sensitive to a variety of pollutants and disturbances and are one of the most endangered faunal groups in North America (personal communication: J. Brim Box, CTUIR, April 2004). Some of the likely causes of decline in the Umatilla/Willow subbasin include increased sediment input which interferes with mussel filter feeding and oxygen consumption; decreased habitat (low flow areas with stable sediment) resulting from channelization, and input of sewage effluent and pesticides (McMahon 1991).

An important difference in the historical and current mussel populations in the subbasin is the number of taxa. Recent surveys for mussels in the subbasin found only two genera, *Anodonta* and *Gonidea.* However, shell material collected in the subbasin in 2003 suggests that a third genus, *Margaritifera*, was recently extirpated from the subbasin (personal communication: J. Brim Box, CTUIR, April, 2004).

Life History

The life history of the mussels inhabiting the Umatilla/Willow subbasin is not known at this time. However, a generalized life cycle is given here to illustrate the habitat use and complexity of mussel life cycles. This life cycle is from an unpublished report by J. Brim Box (CTUIR).

> Freshwater mussels are unique among bivalves in that they require a host fish to complete their life cycle. Unlike male and female marine bivalves, which release sperm and eggs into the water column where fertilization takes place, fertilization of freshwater mussels takes place within the brood chambers of the female mussel. The female mussel carries the fertilized eggs in the gills until they develop into a parasitic stage called glochidia. Female mussels then release the glochidia into the water column where they must come into contact with a suitable host fish species. Once the glochidia are released they will survive for only a few days if they do not successfully attach to a host fish (O'Brien and Brim Box 1999, O'Brien and Williams 2002). Glochidia may attach to a non-host fish, but the glochidium will fail to encyst and will eventually be sloughed off. After successfully attaching to the host fish, glochidia metamorphose and drop to the substrate to become free-living

juveniles (Jones 1950, Howard 1951). The time required for glochidial metamorphosis varies with water temperature and among mussel species.

The mussel/fish relationship is usually species-specific (Lefevre and Curtis 1912); only certain species of fish can serve as suitable hosts for a particular mussel species. The number of host fish utilized by a mussel species varies. Some mussel species have a very restricted number of host fish species (Watters 1994, Michaelson and Neves 1995) while other mussels parasitize a wide range of fish species (Watters 1994, Haag and Warren 1997). To increase their chances of coming into contact with a suitable host fish, some mussel species lure potential host fish by extending brightly colored portions of their mantles that mimic minnows, insects, or other prey (Coker et al. 1921, Kraemer 1970). In addition, some mussels release glochidia into the water column when light sensitive spots are stimulated by the shadow of a passing fish (Kraemer 1970, Jansen 1990). Other mussel species have evolved elaborate lures resembling fish food as mechanisms to attract specific host fishes (Haag et al. 1995, Hartfield and Butler 1997, O'Brien and Brim Box 1999). Knowledge of the reproductive biology of many mussels is incomplete (Jansen 1990), and the host fishes are known for only about a quarter of the mussel species in North America (Watters 1994).

The duration of the parasitic stage varies from about a week to several months (Fuller 1974, Oesch 1984, Williams et al. 1992), depending on mussel species and as a function of water temperature (higher temperatures causing shorter durations) (O'Brien and Brim Box 1999). After metamorphosis, juvenile mussels drop off from their host fish, and must fall to substrate suitable for their adult life requirements or they will not survive. Suitable substrates include those that are firm but yielding and stable (Fuller 1974). In general, shifting sands and suspended fine mud, clays and silt are considered harmful to both juvenile and mature mussels (Fuller 1974, Williams et al. 1992, Brim Box and Mossa 1999, Brim Box et al. 2002).

Mussels orient themselves on the bottom of a stream with their anterior ends buried in the substrate, usually with the two valves slightly open, which allows the intake of water through an incurrent siphon (and food and oxygen) while allowing waste materials to leave the body through an excurrent siphon (Oesch 1984). Food items include organic detritus, algae and diatoms (Coker et al. 1921, Matteson 1955, Fuller 1974). Increases in fine sediment, whether deposited or suspended, may impact mussels by interfering with feeding and/or respiration (Fuller 1974, Brim Box and Mossa 1999).

Although considered fairly sedentary, adult mussels may move in response to abnormal or transient ecological events. For example, water level fluctuations may cause some mussel species to seek deeper water (Coker et al. 1921, Oesch 1984). Often in late summer, mussel trails are visible as the water recedes. However, mussels colonize upstream areas mainly through the use of the parasitic glochidial life stage. Without this stage, freshwater mussel populations would, over generations, slowly shift downstream.

3.2.3.3 Description of Artificial Production and Captive Breeding Programs

Artificial Production

Artificial production within the Umatilla subbasin includes the summer steelhead, coho, and spring and fall Chinook salmon programs. The summer steelhead, spring Chinook, and subyearling fall Chinook programs are funded by BPA as part of the Northwest Power Planning Council Fish and Wildlife Program. The fall Chinook yearling program is funded under the U.S. Army Corps of Engineers' John Day Mitigation Program, and the coho are produced under the Mitchell Act.

Umatilla Hatchery, constructed and operated under the Fish and Wildlife Program, is the central production facility for the Umatilla Basin Fish Restoration Program. It is operated by ODFW and currently produces summer steelhead, spring Chinook, and subyearling fall Chinook salmon. A number of out of basin hatchery facilities also produce fish for the program. Bonneville Hatchery produces yearling fall Chinook, Little White Salmon Hatchery produces spring Chinook, and Cascade Hatchery and Lower Herman Creek Ponds produce coho salmon.

An integral part of the artificial production program for the basin also includes juvenile acclimation and adult holding and spawning satellite facilities. These facilities are all operated by CTUIR under the Umatilla Hatchery Satellite Facilities Operation and Maintenance project. There are five acclimation facilities in the basin: Bonifer Pond, Minthorn Springs, Imeques C-mem-ini-kem, Thornhollow, and Pendleton (Figure 80). The first acclimation facility (Bonifer) was constructed and began operations in 1983. With the completion of the Pendleton facility in 2000, all but two groups of juvenile salmon and steelhead released into the basin are now acclimated. One group of fall Chinook subyearlings is being direct stream released in the mainstem Umatilla River to evaluate alternative release strategies to improve smolt to adult survival. One group of summer steelhead smolts is being direct stream released into Meacham Creek because of poor rearing and release conditions at the Bonifer pond acclimation site.

There are also three adult facilities associated with the Fish Restoration Program. Summer steelhead are held and spawned at Minthorn, fall Chinook at Three Mile Falls Dam, and spring Chinook at South Fork Walla Walla (Figure 80). Three Mile Falls Dam may also be used for holding and spawning coho salmon. Broodstock for these facilities are collected and transported from the Three Mile Falls Dam Adult Trapping and Handling Complex by the Umatilla River Fish Passage Operations project. The number of broodstock collected at Three Mile Falls Dam and green eggs taken for each species is listed in Table 34.

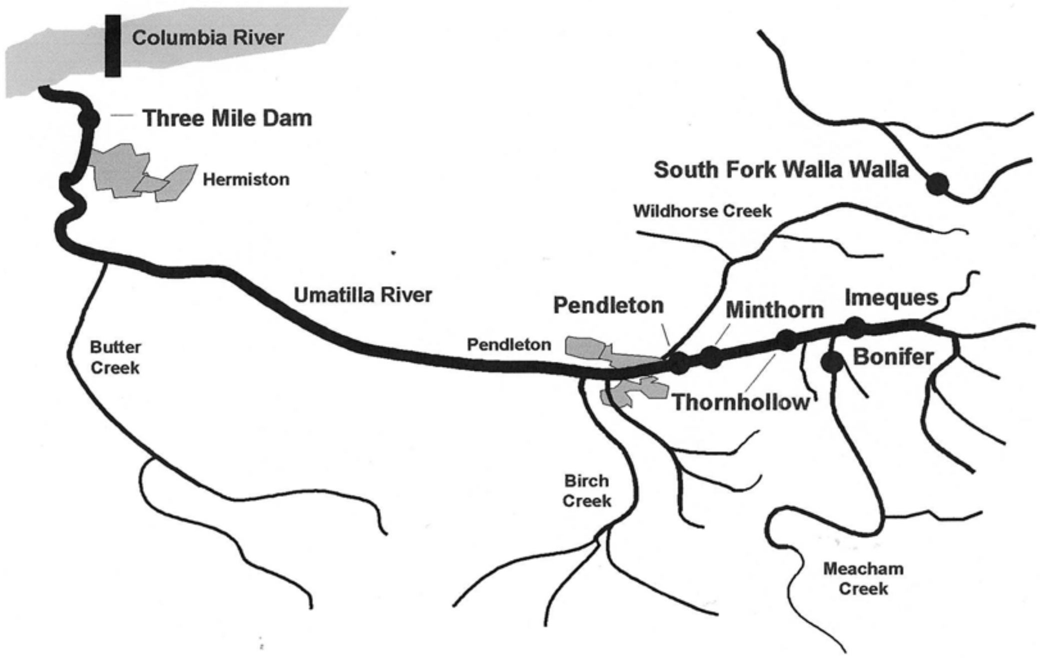


Figure 80. Locations of the CTUIR satellite hatchery facilities. Figure from Rowan (2003).

Table 34. The number of broodstock collected at Three Mile Falls Dam and green eggs taken for each species from 1983 to 2003. Data provided by ODFW, April, 2004.

Brood Year	**Summer Steelhead**		**Coho**		**Fall Chinook**		**Spring Chinook**	
	Number of Brood Collected	Number of Green EggsTaken	Number of Brood Collected	Number of Green Eggs Taken	Number of Brood Collected	Number of Green Eggs Taken	Number of Brood Collected	Number of Green Eggs Taken
1983	161	132,000						
1984	52	100,000						
1985	104	150,000						
1986	69	166,000						
1987	148	239,760						
1988	133	121,980						
1989	150	214,712						
1990	92	130,274						
1991	202	410,356			347	601,548		
1992	225	476,871			211	195,637		
1993	128	255,441	580	676,171	347	352,320		
1994	135	234,432						
1995	154	223,525	860	945,828				
1996	133	215,408			576	778,058		
1997	110	209,639			299	641,961	597	1,029,237
1998	116	228,622			199	257,311	202	455,953
1999	128	224,716			464	541,821	631	942,988
2000	130	200,825			603	1,081,481	619	1,120,995
2001	115	226,685			486	732,205	630	1,175,281
2002	110	180,955			559	678,122	586	1,017,113
2003	109							
Total	**2,704**	**4,342,201**	**1,440**	**1,621,999**	**4,091**	**4,778,983**	**3,265**	**5,741,567**

Summer Steelhead

The first releases of hatchery summer steelhead occurred from 1967 through 1970 and were of Skamania and Oxbow stocks (Appendix B, Table 5). The first release of Umatilla stock steelhead occurred in 1975 and releases every year since have been of endemic stock. Broodstock for the program are collected at Three Mile Dam on the lower Umatilla River. Historically, numbers released and release locations have varied; however, the current program is to acclimate and release 150,000 smolts in the basin annually: 50,000 direct stream released into Meacham Creek, 50,000 acclimated at Minthorn springs and 50,000 acclimated at Pendleton (Appendix B, Table 6). However, the Bonifer acclimation site is not being used due to poor rearing and release conditions. The group of fish previously acclimated and released from Bonifer Pond is now direct stream released into Meacham Creek at the mouth of Boston Canyon.

In addition, to the artificial propagation and introduction of hatchery steelhead, rainbow trout have been stocked in the subbasin to provide a sports fishery. Widespread stocking of rainbow trout occurred throughout the subbasin from the 1940s until the 1970s. A more controlled and limited stocking program was started by ODFW in 1994 and involved stocking trout in the upper Umatilla mainstem and McKay Creek as well as in Willow Creek. However, all stream stocking of rainbow trout in the Umatilla River and its tributaries ceased in 1999 as a result of concerns regarding interbreeding between rainbow trout and summer steelhead. The numbers and locations of stocked rainbow trout during the 1990s program are shown in Appendix B Tables 7 and 8.

Spring Chinook

Spring Chinook salmon from Carson stock have been released since 1986 (Appendix B, Table 9). Beginning with the 1998 releases, Carson stock spring Chinook returning to the Umatilla River have been the primary broodstock source for the Umatilla River program (Appendix B, Table 9). The goal for the program is to collect all broodstock at Three Mile Dam. Historically, numbers released and release locations have varied, however, the current program is to acclimate and release 810,000 yearling smolts annually into the upper mainstem Umatilla River (Appendix B, Table 10).

Fall Chinook

Fall Chinook salmon have been released in the Umatilla River Basin every year since 1982 (Appendix B, Table 11). These releases have included both yearling and subyearling life history stages. The 1982 release was from Spring Creek tule stock. Since then, all releases have been of upriver bright stock. Upriver brights returning to the Umatilla River have been the primary broodstock source for the yearling John Day Mitigation Program since 1997. Historically, numbers released and release locations have varied, however, the current program is to acclimate and release 480,000 yearling and 600,000 subyearling smolts annually into the mainstem Umatilla River.

In addition to the juvenile release programs, an adult fall Chinook-outplanting program was initiated in 1996. Surplus upriver bright stock from Priest Rapids and Ringold Springs hatcheries are released into natural production areas in the mid Umatilla River. The goal of the program is to release 1,000 adults annually. Actual releases have ranged from 200 to 970. (Table 35).

Table 35. Fall Chinook adult outplants released into the Umatilla River since 1996.

Year	Number of adults released
1996	712
1997	940
1998	200
1999	970
2000	471
2001	943
2002	Not Available
2003	Not Available

Coho

Coho salmon have been released from 1966 through 1969 and from 1987 to the present and have been primarily of Tanner Creek stock (Appendix B, Table 12). Broodstock for the program are collected at Bonneville Hatchery. Historically, numbers released and release locations have varied, however, the current program is to acclimate and release 1,500,000 smolts annually into the mainstem Umatilla River at the Pendleton Acclimation Facility (Appendix B, Table 6).

Pacific Lamprey

CTUIR has been working cooperatively with the USGS-Biological Resource Division, Columbia River Research Lab (CRRL) in Cook, WA to develop and refine artificial propagation techniques for Pacific lamprey. Lamprey were collected from the John Day River in 1998 and manually spawned at CRRL in June 1998. Although these techniques have not been finalized and are still under refinement, artificial propagation is one option that the CTUIR is considering for reestablishment of Pacific lamprey in CTUIR's ceded areas.

Lamprey collected from the John Day River and the John Day Dam are being used to reestablish larval abundance in the Umatilla River by outplanting them in prime natural production locations close to spawning time. Collected lamprey are transported to the CRRL, and treated with oxytetracycline at a dose of 10 mg/kg for bacterial infections and treated with 37% formaldehyde (formalin) for external parasites. Fish are maintained in 0.9-m diameter tanks supplied with river water at a temperature of 6-8°C. To induce sexual development of lamprey, water temperature was increased from 6°C in May to 15°C by mid June 2000. They are then transported to the Umatilla River for outplanting. A summary of the number and location of outplants is given in Appendix B Table 13.

Artificial Production and Introduction: Ecological Consequences

To date, there has been little direct study into the ecological consequences of artificial production and introductions in the Umatilla/Willow subbasin and this is a significant data gap. Perhaps the most significant finding to date on the consequences of artificial production/introduction in the subbasin is the work of Currens and Schreck (1995) on the population genetics or rainbow trout. The authors found that that so much genetic variation existed in juvenile redband/steelhead from within a sampling location that it was difficult to detect geographic patterns among fish from different tributaries within the subbasin or to differentiate redband trout from steelhead. However, redband trout sampled from McKay Creek above McKay Dam (which are separated from steelhead and other redband trout in the subbasin by McKay Dam) were genetically distinct from all the other redband trout in the subbasin. The authors reported that the most likely cause for genetic divergence of this group of fish from others in the Umatilla basin is the introduction of genetic material from females of non-native (stocked) strains of rainbow trout. Therefore, stocking of redband trout has led to a genetically distinct population in the subbasin.

Another potentially important ecological consequence of introductions has been inclusion of additional predators into the subbasin. As mentioned in section 3.1.1.5, several species of centrarchid sunfishes were introduced into both the Umatilla and Willow subbasins in the later part of the 20th century. These introductions occurred in both McKay and Willow Creek reservoirs. At this time the only known significant colonization of centrarchid fish in lotic habitats has been that of smallmouth bass in the lower Umatilla River. No information exists on the abundance or productivity of this population of exotic predators, however, it can be hypothesized that these fish are preying on rearing and outmigrating salmonid juveniles and other native fishes. However, evidence from the John Day Reservoir indicates that, at least in that system, smallmouth bass are not important predators of outmigrating smolts (Rieman et al. 1991; Beamesderfer and Ward 1994).

The reintroduction of spring Chinook could be benefiting bull trout by restoring part of their historic prey base. The summer rearing distribution of these overlaps very closely, therefore, juvenile spring Chinook would be very much available to bull trout as prey. No study of this interaction has been done, and is therefore is hypothetical in nature.

The artificial production program through the release of large numbers of salmonid smolts in the spring could have a number of ecological consequences. For example, the elevated number of smolts in the river could be attracting avian predators to the area that were not present historically. Inter- and intra-specific competition might be severe given the number of smolts released. Severe intra-specific competition between hatchery released smolts and naturally produced smolts could have important consequences for the size and survival of naturally produced steelhead and salmonids. However, there has been no direct study of predator-prey interactions or competition within and between species in the Umatilla/Willow subbasin and this remains a significant data gap.

Relationship between naturally and artificially produced populations

Because the native salmon populations in the basin went extinct and have been reintroduced with hatchery stocks, comparisons of the hatchery and naturally producing fish have not been made. However, steelhead were not extirpated from the subbasin, but natural production has been augmented by hatchery releases since 1967. Differences in life history characteristics of naturally and hatchery produced steelhead are outlined below. To date no studies have specifically addressed interactions between naturally produced and hatchery steelhead and this is an important data gap.

Chess et al. (2003) summarized various characteristics of natural and hatchery steelhead returning to the Umatilla River. The authors found the following:

- For timing of adult returns to TMFD no large scale seasonal separation was found between natural and hatchery steelhead; however, at a monthly scale within years return timing is significantly different between hatchery and naturally produced adults for most years examined (return years 1992-1993 to 1999-2000).

- The percentage of both males and females of natural and hatchery origin were found to be significantly different for run years 1992-93 through 2001-02. Natural female steelhead comprised 69.3 % of the natural return while females comprised 57.3% of the hatchery return. Natural male steelhead comprised 30.7 % of the natural return while males comprised 42.7% of the hatchery return (Chess et al. 2003).

- Natural steelhead smolts begin outmigrating earlier than hatchery smolts although this is heavily influenced by the timing of release of the hatchery smolts.

- Hatchery production is intended to be used as a tool to increase adult returns. Data on the ratio between of the number of adult returns per “spawner” (or broodstock individual) indicates that adults harvested for broodstock return more adults than natural producers (Figure 81). In terms of producing beyond replacement, hatchery steelhead were above replacement in 7 of 8 years examined, while naturally spawning steelhead were above replacement in only 2 of 10 years examined (Figure 81).

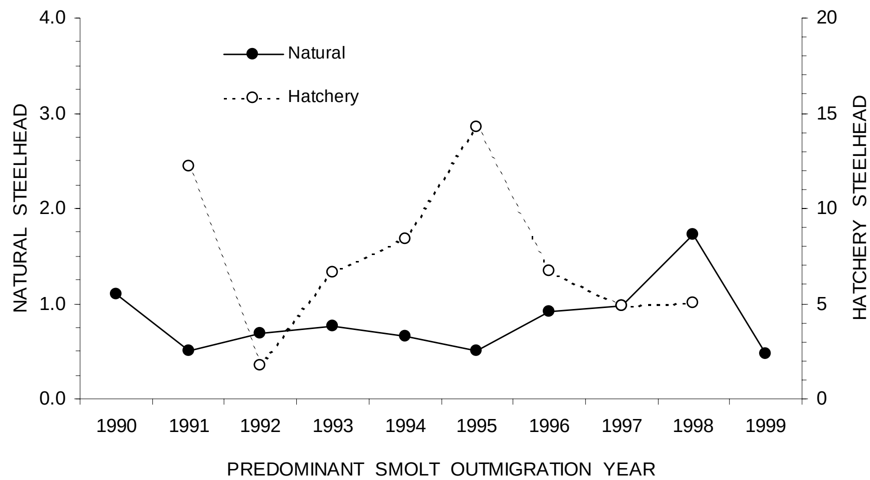


Figure 81. The adult returns per spawner ratio for naturally spawning fish and hatchery broodstock fish. A value of 1 indicates that the population is replacing itself (i.e., one adult returns for every spawner). Figure from Chess et al. (2003).

Finally, information collected by the CTUIR exists to compare the ability of hatchery and naturally produced steelhead to spawn. Observations at steelhead spawning grounds suggest that hatchery-reared fish contribute to natural production to a similar level as naturally-reared fish. In 2001, 23 observations were made of spawning individuals in which the identity, natural vs. hatchery, could be determined. Hatchery-reared fish made up 26.1% of the spawners and naturally-reared fish made up the other 73.9%. In the same year, the fish available to spawn were 26.6% hatchery-reared and 73.4% naturally-reared. In 2002 a similar trend was found. Hatchery-reared fish made up 45.2% of the observed spawners and naturally-reared fish made up the other 54.8% (from a total of 42 observations), and the fish available to spawn were 34.7% hatchery-reared and 65.3% naturally-reared (Kissner 2003).

3.2.3.4 Harvest in the Subbasin

Bull Trout

No estimates of harvest are available for bull trout fisheries, either historic or current. Prior to 1986, the bag limit and season length were the same as those for trout discussed below. In 1986, harvest was restricted to two bull trout over 16 inches. In addition to a sports fishery, tribal angling accounted for some harvest, but most tribal members release bull trout (Buchanan et al. 1997). By 1994 the taking of bull trout was prohibited and in 1998 bull trout in the Columbia River basin were listed as threatened by the USFWS (2002). In the Umatilla/Willow subbasin a prohibition on all angling for bull trout has been in place since 2002.

Redband Trout

No estimates of harvest are available for resident trout fisheries, either historic or current. Streams in the Umatilla/Willow subbasin have had a general trout season throughout modern times. It is likely that small numbers of anadromous steelhead juveniles are harvested in the Umatilla subbasin as part of the general trout season, but as with other fisheries, regulations have become increasingly restrictive primarily to protect anadromous juveniles. The general trout season opens the last week of May through the end of October and this season format has been in place for decades. Prior to 1998, the bag limit was 5 trout over 6 inches in length. In 1998 the minimum length was increased to 8 inches to further protect anadromous juveniles. In 1997, the Umatilla River and tributaries upstream of the confluence of Ryan Creek were closed to harvest (however, catch and release with the use of flies and lures is allowed) to improve the trout fishery and provide further protection of anadromous juveniles.

Non-anadromous streams are generally opened the third weekend of April and closed the end of October; size and bag limits are the same as those listed above for anadromous streams.

Summer Steelhead

Non-tribal fisheries for summer steelhead have existed throughout modern times, although as the need for conservation has increased, angling and harvest opportunities have changed. Since the 1992-93 run year, all non-fin clipped steelhead are required to be released unharmed. The open season has been September 1 though April 15 since the 1992-93 run year as well. Prior to this the season was open from December 1 through March 31. The bag limit varied over the years from two fish/day – 10/year, to two fish/day – 40/year, and finally two fish/day – 20/year. The open area for the fishery is from the mouth upstream to the western boundary of the Umatilla Indian reservation upstream from the Hwy 11 Bridge in Pendleton. See Appendix B Table 14 for a synopsis of non-tribal angling seasons.

An intensive creel census has been conducted on the non-tribal fishery since the 1992-93 run year, prior to this harvest was determined by estimates developed from annual punch cards returned by anglers. Punch card estimates are subject to response bias and provide data with a low level of confidence. ODFW harvest data estimates that sport anglers catch between 60 to 550 steelhead in recent years, but anglers have only kept up to about 100 steelhead per year. For the entire fishery since the 1992-93 run year, percent of the run caught is 17.1% for natural steelhead and 11.4% for hatchery steelhead, and hatchery steelhead harvest is 8.9% (Appendix B, Table 15). Historic angler punch card data shows harvest of as many as 1900 fish in the past, but these data or much less accurate than the recent creel census data (Appendix B, Table 16).

Tribal harvest estimates average about 46 steelhead over the period from 1992-1993 to 2000-2001 with the harvest of wild steelhead ranging from 0% to 25% of the total harvest (and averaging just under 11%) (Appendix B, Table 17).

The percentage of the steelhead run harvested from the Umatilla River and its tributaries by tribal and non-tribal fishers combined is shown in figure 82. This figure reveals a trend towards an increase in the run harvested over the period from 1992-1993 to 2000-2001.

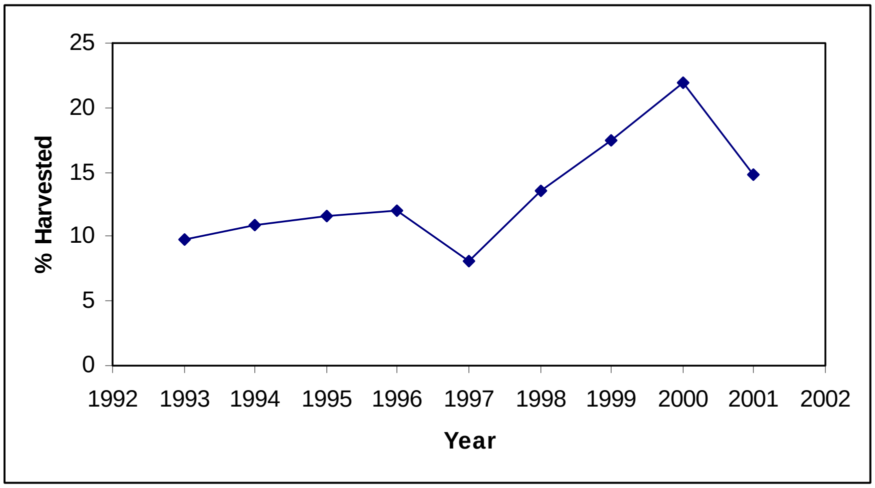


Figure 82. The percentage of the hatchery adult steelhead return harvested by the non-tribal and tribal fishery in the Umatilla River. Data from Chess et al. (2003) and Kissner (2003).

Spring Chinook

As a result of the spring Chinook hatchery program, returns of spring Chinook have been adequate to support tribal and non-tribal fisheries on the Umatilla River in ten out of the last thirteen years. From historical accounts it is known the Umatilla River once provided substantial fisheries for spring Chinook. Van Cleve and Ting (1960) cited reports of tribal and non-tribal fishers harvesting “thousands and thousands” of salmon from spring to fall at the sites of Three Mile Falls and Hermiston Power and Light dams in 1914. Spring Chinook were thought to have been eliminated from the Umatilla Basin shortly after the construction of Three Mile Falls Dam in 1914 (Boyce 1986). However, some angling on a remnant run or strays from other systems occurred in the Umatilla River as recently as 1956 and 1963; however, reported catch rates were low (OGC 1956 and 1963). Spring Chinook fisheries were essentially non-existent for many years prior to 1990 when fish first started returning from the current hatchery program.

The current spring Chinook fishery is managed closely by ODFW and CTUIR to insure that program goals for natural production and broodstock are met in addition to harvest. Annual harvest levels are set depending on the number of returning adults as determined by pre-season return projections. The area of the river open to non-tribal harvest has varied over the years, but is currently from the mouth to the CTUIR western reservation boundary (Appendix B, Table 18).

In 2002, tribal and sport anglers harvested an estimated 990 spring Chinook salmon from the Umatilla River (Appendix B, Tables 18 and 19). Run sizes, angling effort, catch, and harvest for the non-tribal fishery was substantially higher in the 2000-2002 run years than any previous year. Increased effort, catch, and harvest was primarily due to the earlier and longer fishing seasons and the opening of the lower river (below TMFD) initiated in 2000 (Appendix B, Table 18). In contrast, tribal harvest peaked in 2000 and declined thereafter (Appendix B, Table 19).

Between 1991 and 2002 the average harvest of spring Chinook (tribal and non-tribal combined) was 13.4% of the returns to the Umatilla River. While the percent of the run harvested has varied over this period of time, no obvious trends exist in the percent taken (Figure 83). This is true even with the increase in angling effort in recent years as a result of recent large runs.

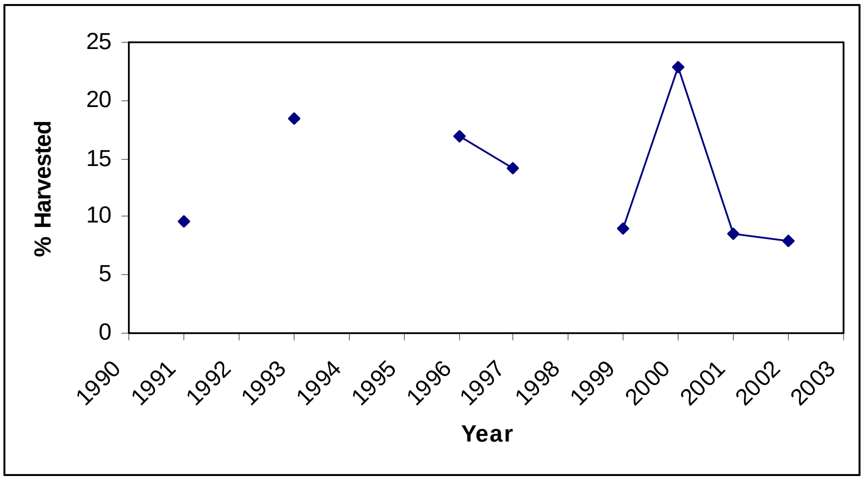


Figure 83. The percentage of the spring Chinook return harvested by the non-tribal and tribal fishery (combined) in the Umatilla River. Because of low return numbers there was no spring Chinook fishery in 1992, 1994, 1995, and 1998. Data from Chess et al. (2003) and Kissner (2003).

Fall Chinook and Coho

As a result of the coho and fall Chinook hatchery programs, a non-tribal sport fishing season for fall salmon has been open since 1989 (Appendix B, Table 20). However, there has been significant contrast in the success of the coho and fall Chinook hatchery programs that has translated to difference in harvest opportunities for these species. The coho hatchery program has been successful in returning relatively large numbers of coho adults to the Umatilla River annually and has resulted in a fishery for adults and jacks that has gradually become more liberal since the first season in 1989. In contrast, the fall Chinook hatchery program has fallen far short of goals for the program and has provided for a jacks only harvest opportunity in order to meet program goals for broodstock and natural production.

While the coho run has provided significant opportunity for sport fisheries, the opportunity for harvest has been limited by the fish's lack of enthusiasm to strike lures. The average number of adult coho caught per year from 1992 to 2001 was 240 and the average number of jacks caught was 62. Over this ten year period the catch composition was 58.9% adults and 41.1% jacks (Appendix B, Table 21). This catch represents only about 5% of the total run for adults, but over 33% of the jack run. In contrast to steelhead there is no evidence of any trends in the percentage of the total run harvested from 1992-2001 (Figure 84). Over 75% of the catch is harvested on average. Table 10 summarizes the coho harvest for 1992-2001.

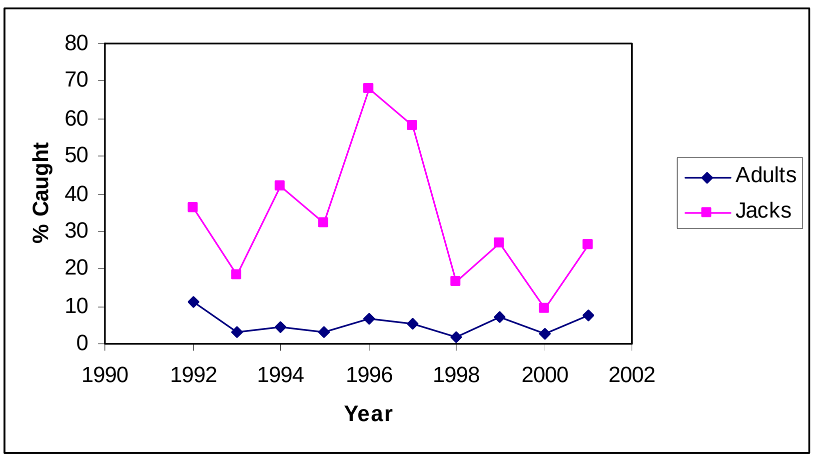


Figure 84. The percentage of the total coho run caught in the Umatilla River by the non-tribal sports fishery. Data from Chess et al. (2004).

Fall Chinook jacks also provide some angling opportunity. Fall Chinook adults are harvested downstream of the Highway 730 bridge (approximately RM 0.25), which is used to define the boundary between the Columbia and Umatilla Rivers for purposes of sport angling regulations. These regulations do not allow for harvest in the Umatilla River (Appendix B Table 20); however, surveys are made of the number of adults caught in the Umatilla River below the Highway 730 bridge to estimate the percentage of the total run harvested (Appendix B, Table 21). The average number of adult fall Chinook caught per year from 1992 to 2001 was 50, the average number of jacks caught was 40, and subjacks 174 (Appendix B, Table 21). Over this ten year period catch composition has averaged 54.8 % subjacks, 27.8% adults, and 17.4% jacks for fall Chinook (Appendix B, Table 21). This catch represents on average 8.6% of the adult run, 12.3% of the jack run, and 27.7% of the subjack run (Appendix B, Table 21). As with coho, no obvious trend exists over the ten years surveyed in the percent of the fall Chinook run harvested (Figure 85).

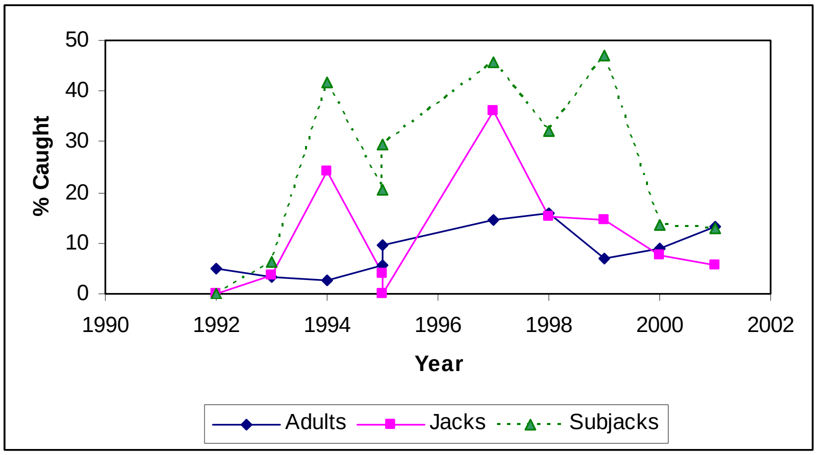


Figure 85. The percentage of the total coho run caught in the Umatilla River by the non-tribal sports fishery. Data from Chess et al. (2004).

Tribal harvest of fall Chinook and coho salmon runs has been monitored via post-season interviews from 1996 to 2003. No tribal effort or catch was reported during these interviews. For example, in 2003 95 tribal anglers were interviewed and none reported fishing in the subbasin for fall Chinook or coho while many reported harvesting steelhead and spring Chinook (personal communication: C. Contor, Fisheries Biologist, CTUIR, May, 2004).

3.2.4 Terrestrial Focal Species Population Delineation and Characterization

3.2.4.1 Population Data

Because of the importance of habitat in focal species selection, information on populations of the ten terrestrial focal species is arranged by habitat type. More detailed descriptions of each habitat type follow in Section 3.2.4.2. In addition, focal species accounts, which include information on life history, large scale distribution and trends, habitat relationships, and appropriate citations to primary literature, are found in Appendix C. However, it should be noted that most of the information presented in the species accounts found in Appendix C are general descriptions of the species throughout their range. Unfortunately, focal species data specific to the Umatilla/Willow subbasin are extremely limited. The following section includes a brief description of the species, and, if known, information on its present distribution and status in the Umatilla/Willow subbasin. More comprehensive information on the relationship of focal species with their habitat, including a description of key environmental correlates, are found in Section 3.4.2.

MIXED CONIFER FOREST FOCAL SPECIES

Pileated Woodpecker (*Dryocopus pileatus*)[1]

The Pileated Woodpecker, the largest woodpecker in the United States, is an excellent excavator and uses its strong chisel-shaped bill to construct nests and roost cavities and to find insects in wood. Because of its dependence on decaying large-diameter trees for nesting, roosting, and foraging, it is closely associated with mature stands of forest. Because of its habitat needs, it is primarily associated with intermediate elevations; habitats at higher and lower elevations tend to lack trees large enough for nesting, roosting, and foraging.

In the Umatilla/Willow subbasin, the Pileated Woodpecker is an uncommon permanent resident in the Blue Mountains (Figure 86). Little information is available about its abundance, fine scale distribution, or status in the Umatilla/Willow subbasin. However, the conversion of stands dominated by grand fir to an earlier seral stage dominated by ponderosa pine likely reduces the amount of suitable habitat for the Pileated Woodpecker in northeastern Oregon. Although Breeding Bird Survey data for 1966-1991 show no significant change for the Pileated Woodpecker in the western United States, it is listed as a vulnerable sensitive species in Oregon (Table 20) and appears on the Oregon PIF list (Table 26).

[1] Information presented in this section is largely derived from Bull 2003 and the focal species accounts presented in Appendix C.

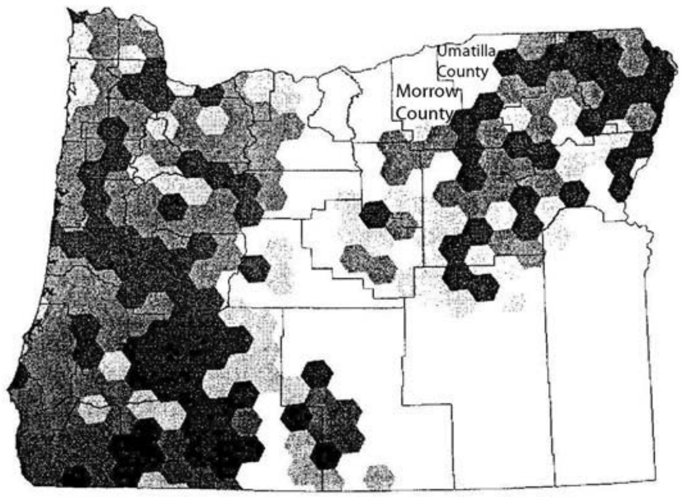


Figure 86. Map of Oregon breeding distribution during 1995-1999 for the Pileated Woodpecker. Darkly shaded hexagons indicate confirmed breeding observations, intermediately shaded hexagons indicate probable breeding observations, and lightly shaded hexagons indicate possible breeding observations. Map adapted from Marshall et al. 2003.

PONDEROSA PINE FOCAL SPECIES

White-headed Woodpecker *(Picoides albolarvatus)*[2]

The White-headed Woodpecker occurs primarily in open ponderosa pine or mixed-conifer forests dominated by ponderosa pine (Bull et al. 1986, Dixon 1995a,b, Frenzel 2000), and is the only woodpecker that relies heavily on the seeds of ponderosa pine for food. In Oregon, White-headed Woodpecker population density was found to increase with increasing volumes of old-growth ponderosa pine and large-diameter ponderosa pines in both contiguous and fragmented sites (Dixon 1995 a,b). Individuals usually excavate nest cavities in snags, but have also been found to use stumps, leaning logs, and the dead tops of live trees (Milne and Hejl 1989, Frederick and Moore 1991, Dixon 1995a,b)

In the Umatilla/Willow subbasin, the White-headed Woodpecker is an uncommon permanent resident in the Blue Mountains (Figure 87), and suitable habitat in the area is believed to be limited. Although the White-headed Woodpecker has occasionally been observed in the mid to upper elevations of the subbasin since 1985 (personal communication: Charles Gobar, USFS, January 2001), little information is available about its abundance, fine scale distribution, or status in the Umatilla/Willow subbasin. Although its overall range in Oregon appears to be similar to historic patterns (Gabrielson and Jewett 1940), the woodpecker's distribution is believed to have become more patchy

[2] Information presented in this section is largely derived from Marshall 2003 and the focal species accounts presented in Appendix C.

because of habitat deterioration associated with timber harvest and fire suppression. Studies in other areas of Oregon (the Deschutes and Winema National Forests), which are believed to have some of the best remaining habitat for this bird in Oregon, have shown that population recruitment was insufficient to offset mortality (Frenzel 2000). Thus, populations in the Umatilla/Willow subbasin are believed to be facing serious threats; an assertion supported by the conclusion made by Gilligan et al. (1994) that severely degraded habitats in the Blue Mountains have resulted in this bird being "now quite scarce." The White-headed Woodpecker is listed as a critical sensitive species in Oregon (Table 20) and appears on the Oregon PIF list (Table 26).

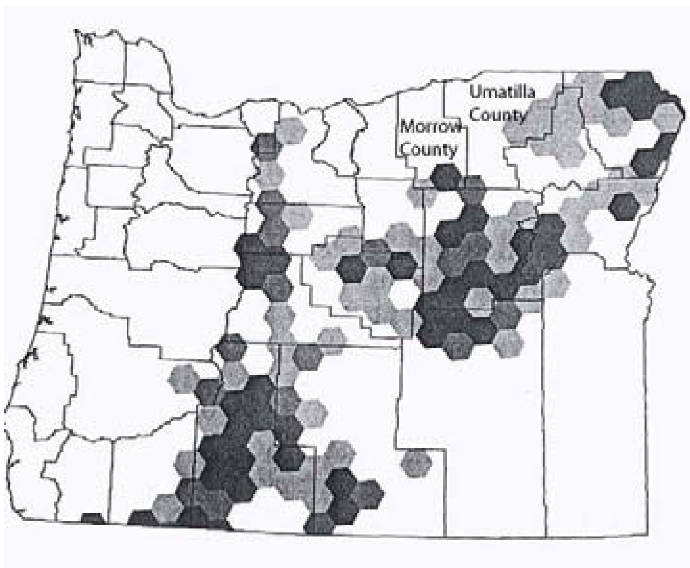


Figure 87. Map of Oregon breeding distribution during 1995-1999 for the White-headed Woodpecker. Darkly shaded hexagons indicate confirmed breeding observations, intermediately shaded hexagons indicate probable breeding observations, and lightly shaded hexagons indicate possible breeding observations. Map adapted from Marshall et al. 2003.

UPLAND ASPEN FOREST FOCAL SPECIES

Red-naped Sapsucker (*Sphyrapicus nuchalis*)[3]

Red-naped Sapsuckers are strongly associated with aspen stands east of the Cascades, where they feed on sap, cambium, and soft parts beneath a tree's bark. Foraging activity is often evident by rows of neat holes drilled in the bark of trees. Red-naped sapsuckers build nesting cavities in aspen, and prefer trees that have heartwood decay (Kilham 1971a). Because of their nesting and foraging activity, Red-naped sapsuckers are considered a double keystone species because the nest cavities are used by secondary cavity-nesters and its sap wells provide food for a variety of other animals, from insects to other birds to squirrels (Daily et al. 1993).

[3] Information presented in this section is largely derived from Simmons 2003 and the focal species accounts presented in Appendix C.

The Red-naped Sapsucker is a common summer resident throughout forested mountains east of the Cascades and it migrates in spring and fall through the mountains and forested lower elevations. Although numerous confirmed breeding observations have been made in the Umatilla/Willow subbasin (Figure 88), little information is available about its abundance, fine scale distribution, or status in the Umatilla/Willow subbasin. Although Breeding Bird Survey data for Oregon showed a non-significant 0.5% increase per year from 1966-2000 (Sauer et al. 2000), long-term widespread degradation of aspen and other riparian forest through intensive livestock grazing and fire suppression are believed to pose a significant threat to the species because of its dependence on large aspen trees and snags for nesting. A lack of tree regeneration and the resulting loss of large trees are expected to lead to significant declines in Red-naped Sapsucker populations (Dobkin et al. 1995). The Red-naped Sapsucker appears on the Oregon PIF list (Table 26).

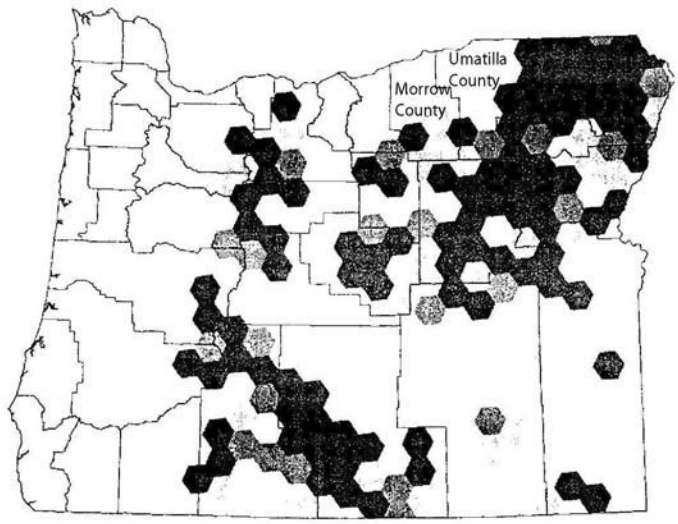


Figure 88. Map of Oregon breeding distribution during 1995-1999 for the Red-naped Sapsucker. Darkly shaded hexagons indicate confirmed breeding observations, intermediately shaded hexagons indicate probable breeding observations, and lightly shaded hexagons indicate possible breeding observations. Map adapted from Marshall et al. 2003.

WESTERN JUNIPER WOODLAND FOCAL SPECIES

Ferruginous Hawk (*Buteo regalis*)[4]

The Ferruginous Hawk is Oregon's largest hawk and is associated with open habitats of shrub-steppe and the bunchgrass prairies along the northern foothills of the Blue Mountains. Because of their sensitivity to human disturbance, they tend to reside in remote areas, and prefer areas where their principal prey – grounds squirrels, rabbits, and hares – are common.

[4] Information presented in this section is largely derived from Janes 2003 and the focal species accounts presented in Appendix C.

Although the Ferruginous Hawk is an uncommon to rare resident in open landscapes east of the Cascades, it is relatively common in the Umatilla/Willow subbasin (Figure 89). Quantitative information about its abundance, fine scale distribution, or status in the Umatilla/Willow subbasin is limited, although there is evidence that nesting activity in the lower subbasin has declined in the last 60 years; the number of nests that presently occurs in the low elevation habitat portion of the subbasin is only a fraction of the 28 nests found in 1940 (Gabrielson and Jewett 1940) in northern Morrow and Umatilla Counties (personal communication: R. Morgan, ODFW, February 2001). This decline is believed to be related to the loss of high quality habitat through agricultural conversion. The Ferruginous Hawk is also extremely sensitive to human disturbance and will readily abandon nests if disturbed (Olendorff and Stoddard 1974, White and Thurow 1985). This problem is exacerbated by the tendency of the Ferruginous Hawk to nest in short trees. Although foothill grasslands and shrub-steppe continue to harbor Ferruginous Hawks in the Umatilla/Willow subbasin, their stability is unknown. The Ferruginous Hawk is listed as a critical sensitive species and a PIF species in Oregon.

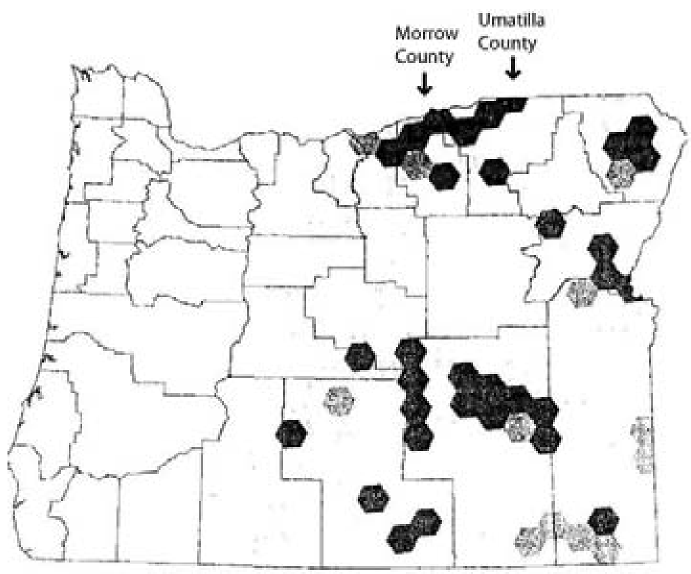


Figure 89. Map of Oregon breeding distribution during 1995-1999 for the Ferruginous Hawk. Darkly shaded hexagons indicate confirmed breeding observations, intermediately shaded hexagons indicate probable breeding observations, and lightly shaded hexagons indicate possible breeding observations. Map adapted from Marshall et al. 2003.

SHRUB-STEPPE FOCAL SPECIES

Sage Sparrow (*Amphispiza belli*)[5]

Sage Sparrows are highly dependent on shrub-steppe habitat; in Oregon, they are most commonly associated with big sagebrush communities, some of which may include a mix of western juniper and other shrubs.

As seen in Figure 90, although Sage Sparrows are most common in southeast and central Oregon, breeding individuals have also been observed in the Umatilla/Willow subbasin. Once abundant in northern Morrow and Umatilla Counties (Gabrielson and Jewett 1940), this bird currently only breeds on a few small remaining habitat tracts – the Umatilla Army Depot and the Boardman Bombing Range. Although Breeding Bird Survey data reveal no significant population trends in Oregon as a whole in the past 30 years, agricultural conversion, livestock grazing, the spread of exotic weeds, and the practice of replacing sagebrush habitat with non-native grasslands, such as crested wheatgrass, have resulted in local populations declines (Wiens and Roteneberry 1985). The extent of shrub-steppe habitat under public ownership has slowed but not stopped the destruction of their requisite habitat (see Section 3.2.4.2). One of the only areas supporting nesting Sage Sparrows in the Umatilla/Willow subbasin, the Boardman Bombing Range, was negatively affected by a large fire (and the post-fire cheatgrass invasion) at the facility in 1988, which eliminated approximately 60% of the known sage sparrow habitat at that location. The Sage Sparrow is listed as a critical sensitive species and a PIF species in Oregon.

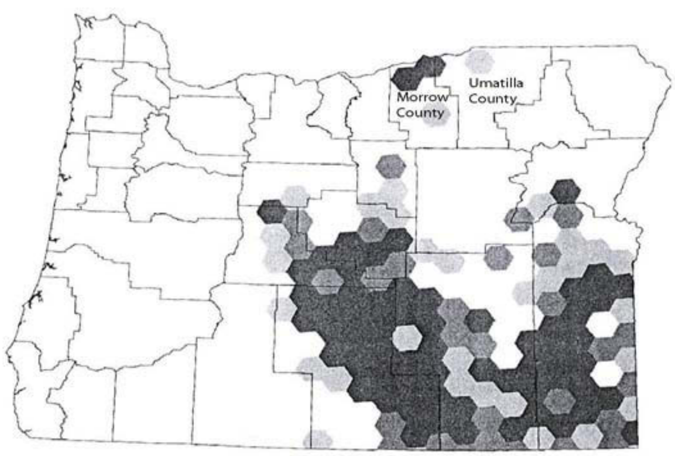


Figure 90. Map of Oregon breeding distribution during 1995-1999 for the Sage Sparrow. Darkly shaded hexagons indicate confirmed breeding observations, intermediately shaded hexagons indicate probable breeding observations, and lightly shaded hexagons indicate possible breeding observations. Map adapted from Marshall et al. 2003.

[5] Information presented in this section is largely derived from Miller 2003 and the focal species accounts presented in Appendix C.

INTERIOR GRASSLAND FOCAL SPECIES

Grasshopper Sparrow (*Ammodramus savannarum perpallidus*)[6]

In Oregon, Grasshopper Sparrows are restricted to grasslands, where they occur in native bunchgrass remnants (Janes 1983). Grasshopper Sparrows sing from elevated perches, a critical habitat feature. In Morrow County, they use the flowering stalks of the large velvet lupine as perches (Janes 1983). However, Grasshopper Sparrows are rarely encountered in habitats with abundant woody shrubs, possibly because of competition with Brewer's Sparrows. Individuals construct a domed nest on the ground, which is concealed under vegetation (Vickery 1996).

The Grasshopper Sparrow is a widespread but very local breeder and rare migrant. As seen in Figure 91, the Grasshopper Sparrow occurs throughout the Umatilla/Willow subbasin, and is especially common in scattered patches along the unforested northern slopes of the Blue Mountains (Janes 1983, Evanich 1992a, Sullivan 1992e). A study in very limited habitats in Morrow County found that densities varied from 1.1 individuals per 100 acres in the Boardman area to 8.2 individuals per 100 acres in the Heppner area (Janes 1983). Holmes and Janes (1983) showed the species was most abundant in the foothill grassland areas of the subbasin and preferred north-facing slopes with undisturbed bunchgrass and lupine (*Lupinus leucophilus*). The status of the species in Oregon is unclear, partially because historic data on the bird is limited because of the difficulty of detection and highly variable annual abundances. However, the conversion of native bunchgrass prairies to dryland wheat and other crops is believed to have negatively impacted the species, and continues to threaten populations in Northeastern Oregon. Many existing pairs persist in bunchgrass remnants between cultivated fields or in marginal habitats with soils that are too shallow to plow. Overgrazing also appears to negatively affect habitat suitability for Grasshopper Sparrows. The species is a state sensitive species (vulnerable/peripheral or naturally rare) and occurs on the Oregon PIF list.

[6] Information presented in this section is largely derived from Janes 2003 and the focal species accounts presented in Appendix C.
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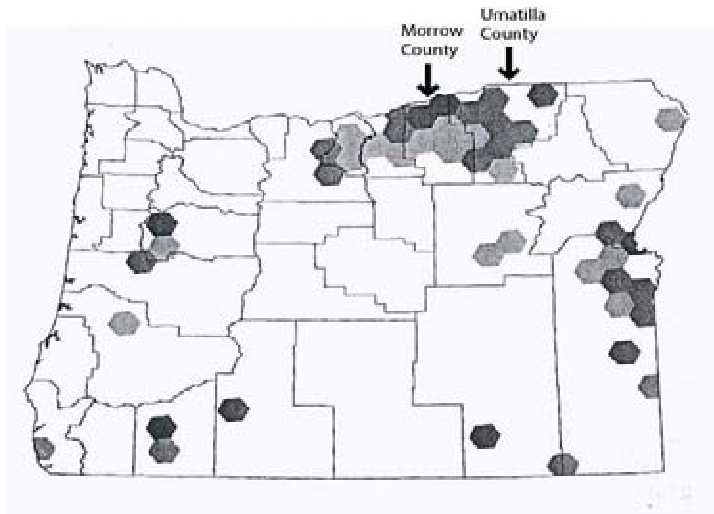

Figure 91. Map of Oregon breeding distribution during 1995-1999 for the Grasshopper Sparrow. Darkly shaded hexagons indicate confirmed breeding observations, intermediately shaded hexagons indicate probable breeding observations, and lightly shaded hexagons indicate possible breeding observations. Map adapted from Marshall et al. 2003.

HERBACEOUS WETLAND FOCAL SPECIES

Columbia Spotted Frog (*Rana luteiventris*)

The Columbia spotted frog is rarely found far from water. It occupies a variety of still water habitats and can also be found in streams and creeks (Hallock and McAllister 2002). Columbia spotted frogs are closely associated with clear, slow-moving or ponded surface waters, with little shade (Reaser 1997). Aquatic sites used by this species may have a variety of vegetation types, from grasslands to forests (Csuti 1997).

Columbia spotted frogs are thought to be widely distributed in eastern Oregon, but local populations appear to be isolated from each other. Most (81%) of the 16 sites known to be inhabited by Columbia spotted frogs in eastern Oregon support fewer than 10 adult frogs, with the exception of a single population of Columbia spotted frogs in the Dry Creek drainage of Malheur County that has hundreds of adults (Munger et al. 1996). Monitoring of Columbia spotted frogs in Wallowa County of northeastern Oregon, which began in 1998, suggests the existence of relatively stable, small local populations (< 5 adults) (Pearl 2000). All known local populations of the species in eastern Oregon appear to be functionally isolated. The current status and distribution of the Columbia spotted frog in the Umatilla/Willow subbasin is undetermined. However, the frog occurs sporadically throughout the Blue Mountains and has occasionally been observed in the middle and lower elevations of the subbasin since 1995. Abundance of the Columbia spotted frog are believed to have decreased dramatically since historical times due to draining, destruction, and degradation of wetlands and the introduction of the bullfrog, although no quantitative data exists to demonstrate this assertion. The Columbia spotted frog is a federal candidate species and an Oregon sensitive species with undetermined status.

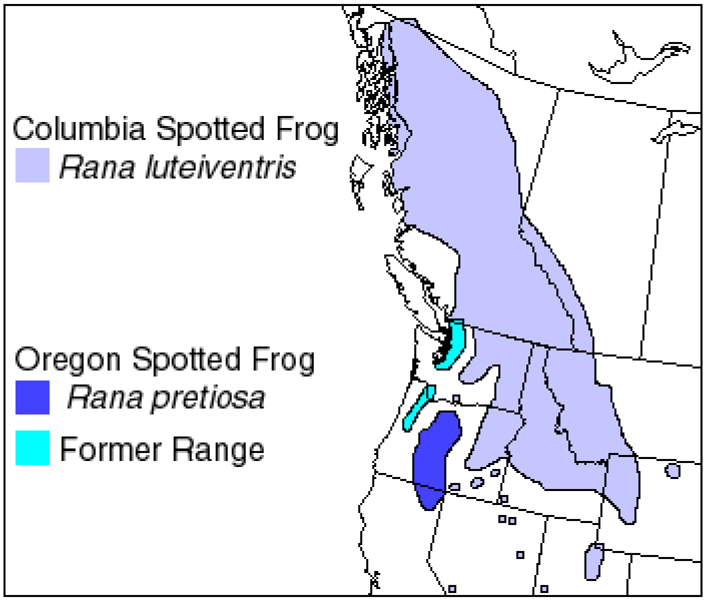

Figure 92. Distribution of the Oregon spotted frog in the Northwest (from Green et al. 1997).

RIPARIAN WETLAND FOCAL SPECIES

Great Blue Heron (*Ardea herodias*)[7]

The Great Blue Heron, the largest heron in North America, is one of the most widespread and familiar waterbirds in Oregon. Great Blue Herons are commonly associated with shallow areas of marshes, lakes, streams, and oceans, where they feed on fish, amphibians, and aquatic invertebrates. Nest colonies occur in a variety of trees, including black cotton wood, red alder, ponderosa pine, and Douglas-fir.

As shown in Figure 93, breeding Great Blue Herons occur in the Umatilla/Willow subbasin. However, little quantitative information exists about their abundance, fine scale distribution, or status in the subbasin. In Oregon as a whole, population size and range may be static, but nesting and foraging habitat has been reduced due to urban development and tree harvesting. The Great Blue Heron is defined as a critically linked species, a HEP species, and a salmon-associated species (see Section 3.2.1).

[7] Information presented in this section is largely derived from Thomas 2003 and the focal species accounts presented in Appendix C.

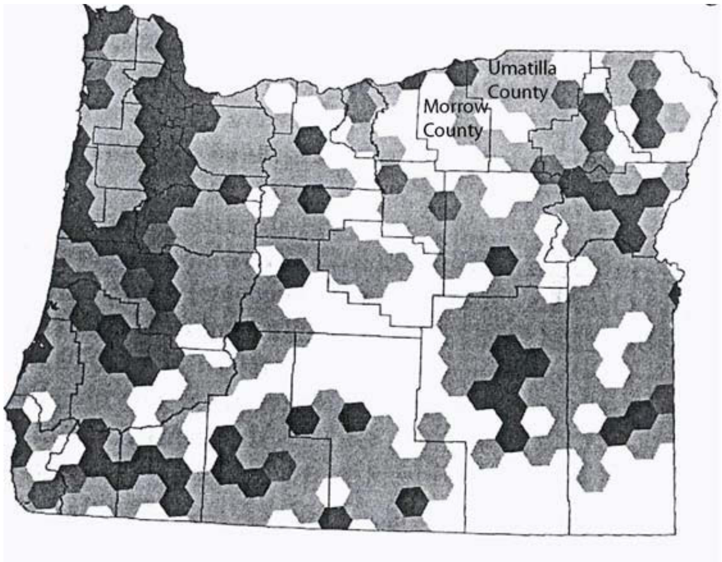

Figure 93. Map of Oregon breeding distribution during 1995-1999 for the Great Blue Heron. Darkly shaded hexagons indicate confirmed breeding observations, intermediately shaded hexagons indicate probable breeding observations, and lightly shaded hexagons indicate possible breeding observations. Map adapted from Marshall et al. 2003.

Yellow Warbler (*Dendroica petechia*)[8]

Yellow Warblers prefer to nest among riparian woodland and thickets, particularly those dominated by willow or cottonwood (Fix 1990a, Gilligan et al. 1994, Sanders and Edge 1988). Cup shaped nests are built in bushes, saplings, or trees within 6.5 feet of the ground (Gabrielson and Jewett 1940, Taylor and Littlefield 1986).

The Yellow Warbler is a common to abundant breeder in the Umatilla/Willow subbasin in the Blue Mountains and along watercourses. However, little quantitative information is available about its abundance, fine scale distribution, or status in the Umatilla/Willow subbasin. In Oregon, Breeding Bird Survey data from 1966-2000 shows a consistent loss of 1.7% each year. This decline is believed to be the result of riparian habitat destruction and degradation. Livestock grazing and the development of farms and pastures have benefited the Brown-headed Cowbird, whose brood parasitism can have an adverse effect on the Yellow Warbler. Yellow Warblers are HEP species and occur on the Oregon PIF list.

[8] Information presented in this section is largely derived from Scheuering 2003 and the focal species accounts presented in Appendix C.

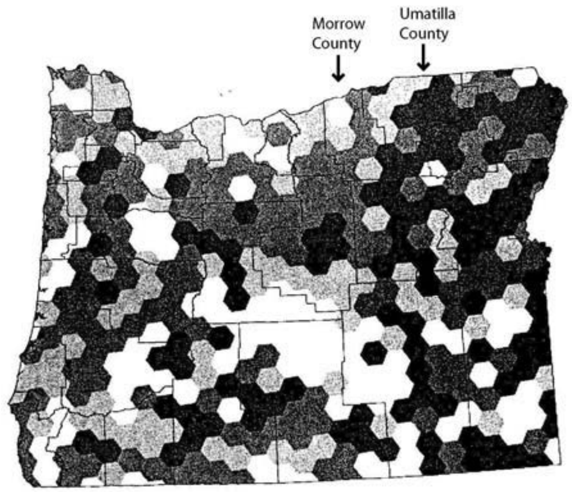

Figure 94. Map of Oregon breeding distribution during 1995-1999 for the Yellow Warbler. Darkly shaded hexagons indicate confirmed breeding observations, intermediately shaded hexagons indicate probable breeding observations, and lightly shaded hexagons indicate possible breeding observations. Map adapted from Marshall et al. 2003.

American Beaver (*Castor canadensis*)[9]

The American beaver (*Castor canadensis*) is a large, highly specialized aquatic rodent found in the immediate vicinity of aquatic habitats. In Oregon, the American beaver can be found in suitable habitats throughout the state (Verts and Carraway 1998), and is almost always associated with riparian or lacustrine habitats bordered by a zone of trees, especially cottonwood and aspen (*Populus*), willow (*Salix*), alder (*Alnus*), and maple (*Acer*) (Verts and Carraway 1998). Small streams with a constant flow of water that meander through relatively flat terrain in fertile valleys and are subject to being dammed seem especially productive of beavers (Hill 1982).

Beaver distribution occurs from the Columbia River to mid-elevation forested regions throughout the Umatilla/Willow subbasin drainage (personal communication: M. Kirsch, ODFW, January 2001). Although American beaver are active in riparian wetlands of the Umatilla/Willow subbasin, there are no quantitative data on its abundance, fine scale distribution, or status in the Umatilla/Willow subbasin. Historically, beaver populations in the area were more expansive until populations were reduced by unregulated trapping, as they were throughout much of the western United States. Currently, the American beaver is a managed game species.

[9] Information derived for this section is derived from the focal species information presented in Appendix C.

3.2.4.2 Distribution and Condition of Habitat Types Associated with Focal Species
Terrestrial wildlife planners took advantage of a new wildlife database, the Interactive Biodiversity Information System (IBIS), to provide information and maps on the historic and current distribution of focal habitats, ownership and protection status for each habitat, and functional redundancy analyses.

The following description describes the process used by the NWHI to develop IBIS maps of current and historical distributions of focal habitats and some of the limitations and assumptions associated with that process (personal communication, Tom O'Neil, NWHI, April 2004):

> <u>Current Conditions:</u>
> NWHI developed a map depicting the current distribution of the 32 wildlife habitats types, described by the Species Habitat Project for the Columbia River basin in the United States. US Geological Survey, Biological Resource Division (USGS/BRD), compiled this map from existing vegetation maps that were created for each state as part of the National Gap Analysis Program. Each state's map is based on interpreting vegetation cover data from satellite imagery. Vegetation maps from all or parts of seven states (Idaho, Montana, Nevada, Oregon, Utah, Washington, and Wyoming) in the Columbia River Basin were used by NWHI to develop the wildlife habitat types map depicting current conditions.
>
> The primary purpose for developing the vegetation maps for the National Gap Analysis Program was for USGS/BRD to conduct statewide biodiversity assessments. Hence, the resolution of their vegetation maps reflects a statewide, regional, or coarse resolution for planning. That is, their maps can serve as an initial basis for large-scale mapping or database investigations but they are more accurately interpreted at the statewide or province scales, and only for some of the largest subbasins.
>
> Hence, the current wildlife-habitat type map provides only an initial depiction of the amounts of wildlife habitats that may exist within watersheds, but is not of sufficient resolution for depicting the site-specific location of habitats within each watershed. The minimum mapping unit for the subbasin-wide map is 250 acres, whereas a more appropriate scale for within watershed assessments would be 10-75 acres depending on land ownership and habitat patch sizes. Thus, wildlife habitats that occur in patch sizes less than 250 acres, e.g. linear riparian habitat, are likely underrepresented in the current map.
>
> Further, there has been no formal validation of the subbasin-wide current wildlife habitat map. Because maps are only a representation of reality and cannot depict all the detail represented in nature, some generalization is unavoidable. Remotely sensed maps developed from photo interpretation or satellite imagery also contain some errors. Conducting an accuracy assessment allows the user to know at a glance what the overall reliability is, so that when decisions are made the accuracy of the map can be taken into account. Because of the size of the mapping area, time frame, and costs, no formal accuracy assessment was done.

However, the National Biodiversity Gap Analysis Program had a goal of 80 percent overall accuracy for each state's vegetation map, and NWHI accepted their stated validity of their map products.

Finally, because there is a desire to move towards subbasin information, which would entail maps produced at finer resolutions than presented in this report, accuracy assessments may be less critical or a lower priority for the current array of map products than for later map products produced at the subbasin scale. We do recognize the importance of conducting accuracy assessments and that they would be critical to the utility and acceptance of subbasin-scale maps as a tool for resource managers. In general, accuracy assessments would entail determining the classification error in maps by using an *a priori* target level of thematic map accuracy (for subbasin mapping we would propose a per class accuracy of 75 percent and overall map accuracy of 80 percent) and designing the empirical assessment (number of sampling points, etc.) based on statistical sampling procedures.

<u>Historic Conditions</u>

NWHI developed an historic map by combining products from two previous works: Interior Columbia Basin Ecosystem Management Project (ICBEMP; USDA Forest Service 1997), and the Oregon Biodiversity Project (Defenders of Wildlife 1998). These two mapping efforts used very different methods. The ICBEMP historic data were mostly derived from a model, whereas at least using surveyors' notes from the 1850 land survey created a portion of the Oregon Biodiversity Project map.

NWHI combined these efforts to create a wildlife habitat map that depicts historic (potential) conditions of the Columbia River Basin in the U.S. The result is a historic map that is a theoretical construct with a coarse (1-km square pixel size) level of resolution designed to give a regional perspective. This map can provide only initial approximations of the presence and distribution of wildlife habitat types within specific subbasins and watersheds because of the need for more detailed information at these levels. Specifically, wildlife-habitat types that are typically small or linear in size or shape (like riparian or herbaceous wetlands) would be under-represented in the historic condition map.

Because of the limitations with the historic map, no validation of this map was done. We are unaware of any previously collected detailed information for all the subbasins and watersheds throughout the specific geographic areas of basin addressed in this project. Further, because there are no recognized historical data sets that would give such a basin perspective, validation would be difficult. Hence, the historic map best depicts gross generalizations of gains or loses of specific wildlife habitat types. Additionally, it can give a user an idea of what potential may have existed within provinces and within larger subbasins.

As discussed above, IBIS identifies 32 different habitat types as occurring in Oregon and Washington. Historically (c. 1850) the Umatilla/Willow subbasin had 13 habitat types (Table 36; Figure 95). According to IBIS, as of 1999 the subbasin still has 13 habitat types, although three habitat types (montane mixed conifer forest, alpine grasslands and shrublands, and desert playa and salt scrub) have been lost and three habitat types (agriculture, pasture, and mixed environs; urban and mixed environs; and montane coniferous wetlands) have been gained (Table 36; Figure 95).

IBIS habitat data that were believed to be inaccurate were either replaced or supplemented with additional sources of data, if available. For example, although IBIS indicates that shrub-steppe habitat has increased substantially since 1850 (Table 36; Figure 95), this increase is believed by the planning team to be primarily due to the increase of rabbit brush in agricultural lands in CRP. As discussed below, more detailed information on shrub-steppe habitat in the lower Umatilla/Willow subbasin is available; these data indicate that the acreages of high quality shrub-steppe in the Umatilla/Willow subbasin have declined significantly (Kagan et al. 1999). Habitat types in which data are believed to be inaccurate or questionable are highlighted in Table 36.

Another caveat that should be noted is that IBIS data reflect presence and absence of habitat only, and do not provide information about habitat quality.

Table 36. Historic acreage and percent cover, current acreage and percent cover, and percent change from historic to current conditions generated by IBIS 2004. Habitat types are listed in order of historic prevalence. Habitat types in which data are believed to be inaccurate or questionable are highlighted.

Habitat Type	Historic Acreage (c. 1850)	Historic Percent Cover	Current Acreage (1999)	Current Percent Cover	Percent Change[2]
Interior Grasslands	2,030,959	78%	528,269	20%	-74%
Shrub-Steppe	273,546	10.5%	628,795	24%	+130%
Ponderosa Pine Forest	143,321	5.5%	162,257	6%	+13%
Interior Mixed Conifer Forest	83,275	3%	167,299	6%	+100%
Open Water	32,371	1%	18,201	< 1%	-44%
Herbaceous Wetlands[1]	18,286	1%	4,670	< 1%	-75%
Montane Mixed Conifer Forest	247	< 1%	0	0%	-100%
Lodgepole Pine Forest	247	< 1%	33	< 1%	-87%
Upland Aspen Forest	1,236	< 1%	46	0%	-96%
Alpine Grasslands and Shrublands	741	< 1%	0	0%	-100%
Western Juniper Woodlands	2,741	< 1%	36,495	1%	+1,377%
Desert Playa and Salt Scrub	8,154	< 1%	0	0%	-100%
Interior Riparian Wetlands[1]	247	< 1%	2,541	< 1%	+928%
Agriculture, Pasture, and Mixed Environs	0	0%	1,023,421	39%	--
Urban and Mixed Environs	0	0%	18,523	1%	--
Montane Coniferous Wetlands[1]	0	0%	482	< 1%	--

[1] IBIS notes that the acreages of these habitats are only general approximations; they are likely underrepresented because of scale issues and available mapping information.

[2] Percent change cannot be calculated for habitats that had no historical acreage.

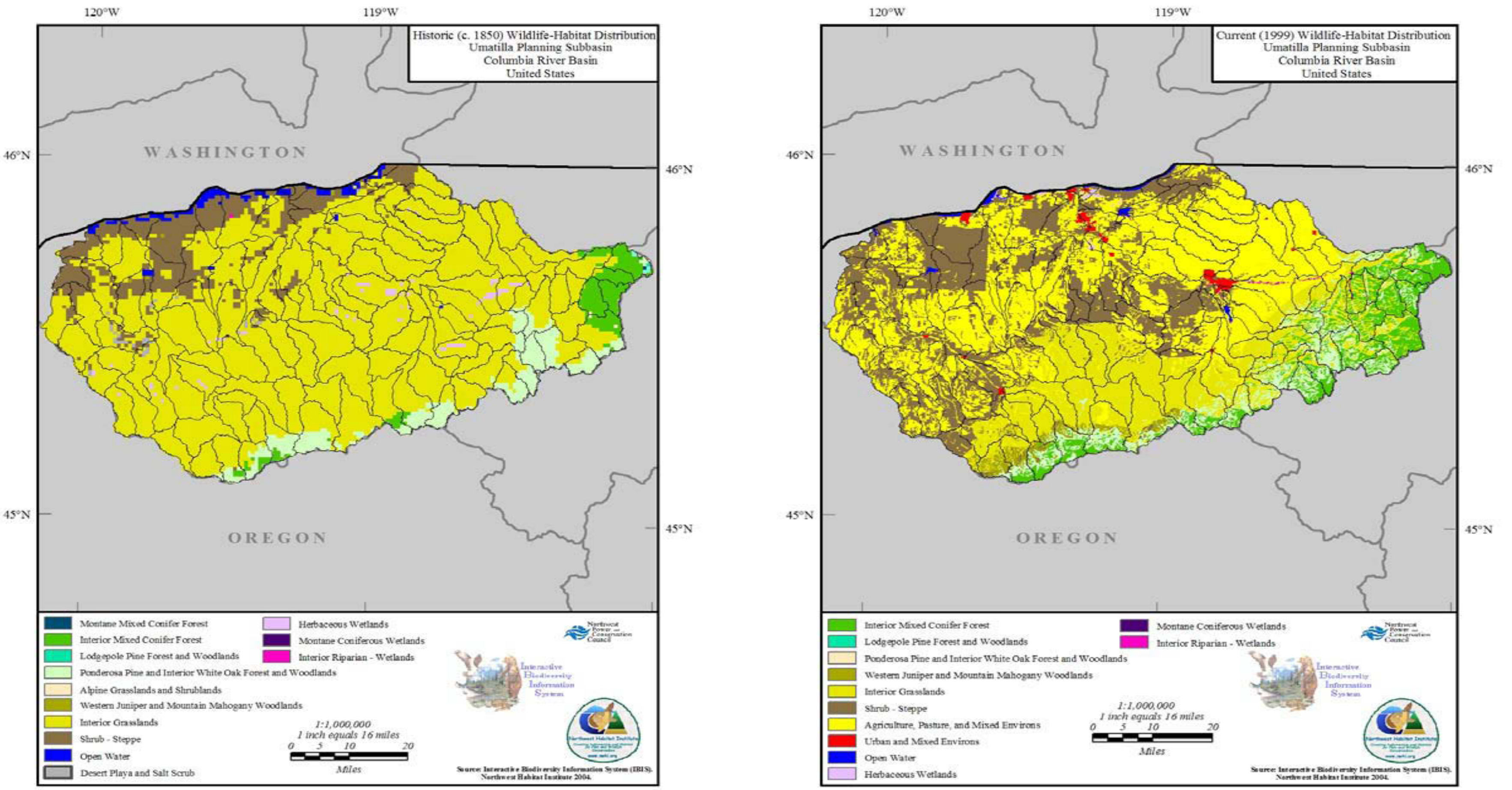

Figure 95. Historic (c. 1850) and current distribution (1999) of habitat types found in the Umatilla/Willow subbasin (IBIS 2004).

IBIS also generates information and maps on protected status (Figure 96; Table 38) and land ownership (Figure 97; Table 39). When data were believed to be inaccurate, alternative sources were used to replace or supplement IBIS data. The definitions of protected status used by IBIS are consistent with four categories described in the USGS Gap Analysis Program Handbook (Table 37; personal communication: C. Langhoff, NWHI, April 2004). Protection and ownership patterns for the eight focal habitat types are discussed in more detail below.

Table 37. Definitions used for gap analyses generated by IBIS. Definitions are from the Gap Analysis Program Handbook (http://www.gap.uidaho.edu/handbook/Stewardship/) and are derived from Scott et al. 1993, Edwards et al. 1994, and Crist et al. 1996.

Protected Status	**Definition**
High	An area having permanent protection from conversion of natural land cover and a mandated management plan in operation to maintain a natural state within which disturbance events (of natural type, frequency, intensity, and legacy) are allowed to proceed without interference or are mimicked through management.
Medium	An area having permanent protection from conversion of natural land cover and a mandated management plan in operation to maintain a primarily natural state, but which may receive uses or management practices that degrade the quality of existing natural communities, including suppression of natural disturbance.
Low	An area having permanent protection from conversion of natural land cover for the majority of the area, but subject to extractive uses of either a broad, low-intensity type (e.g., logging) or localized intense type (e.g., mining). It also confers protection to federally listed endangered and threatened species throughout the area.
None	There are no known public or private institutional mandates or legally recognized easements or deed restrictions held by the managing entity to prevent conversion of natural habitat types to anthropogenic habitat types. The area generally allows conversion to unnatural land cover throughout.

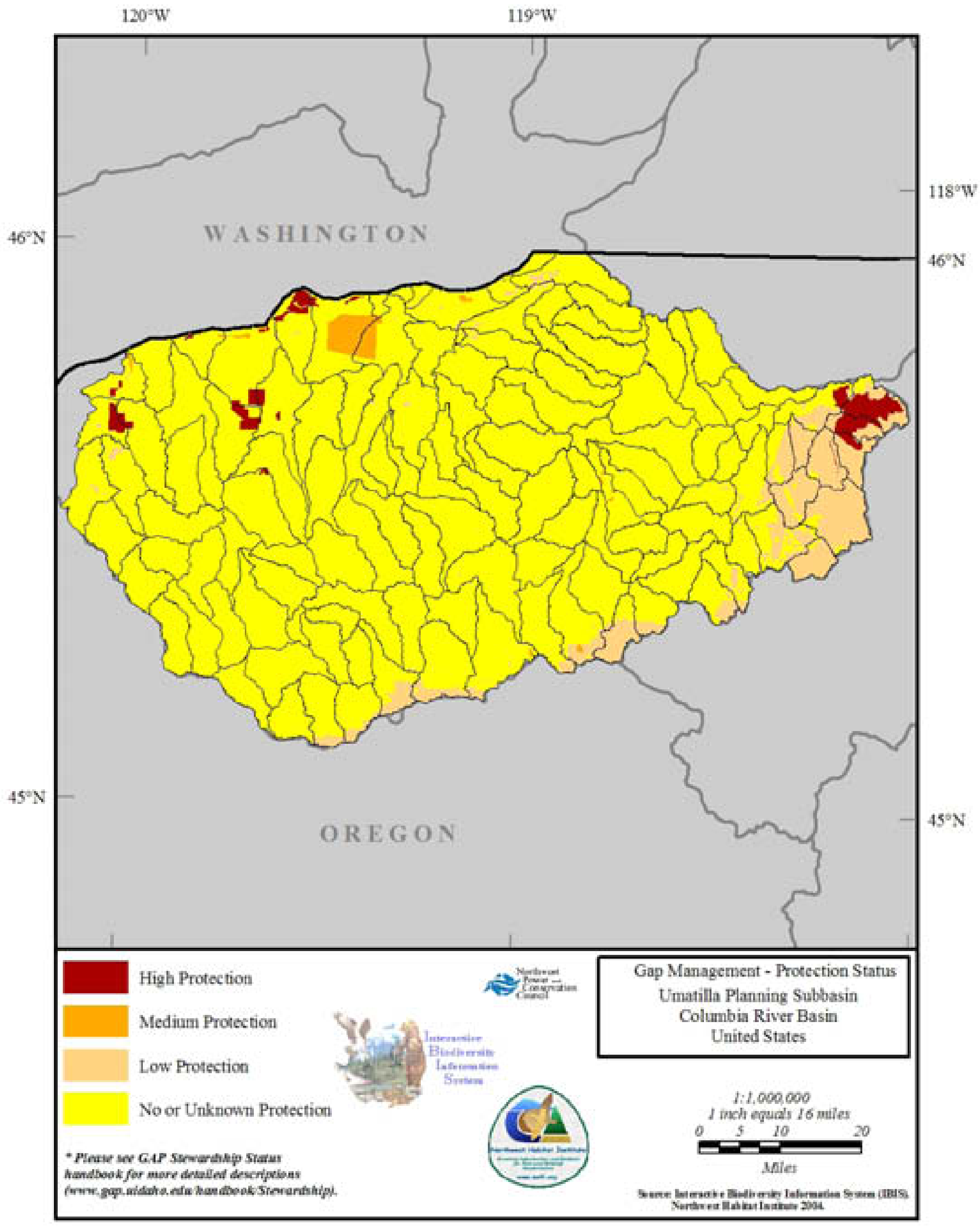

Figure 96. Protection status of habitat found in the Umatilla/Willow subbasin (IBIS 2004).

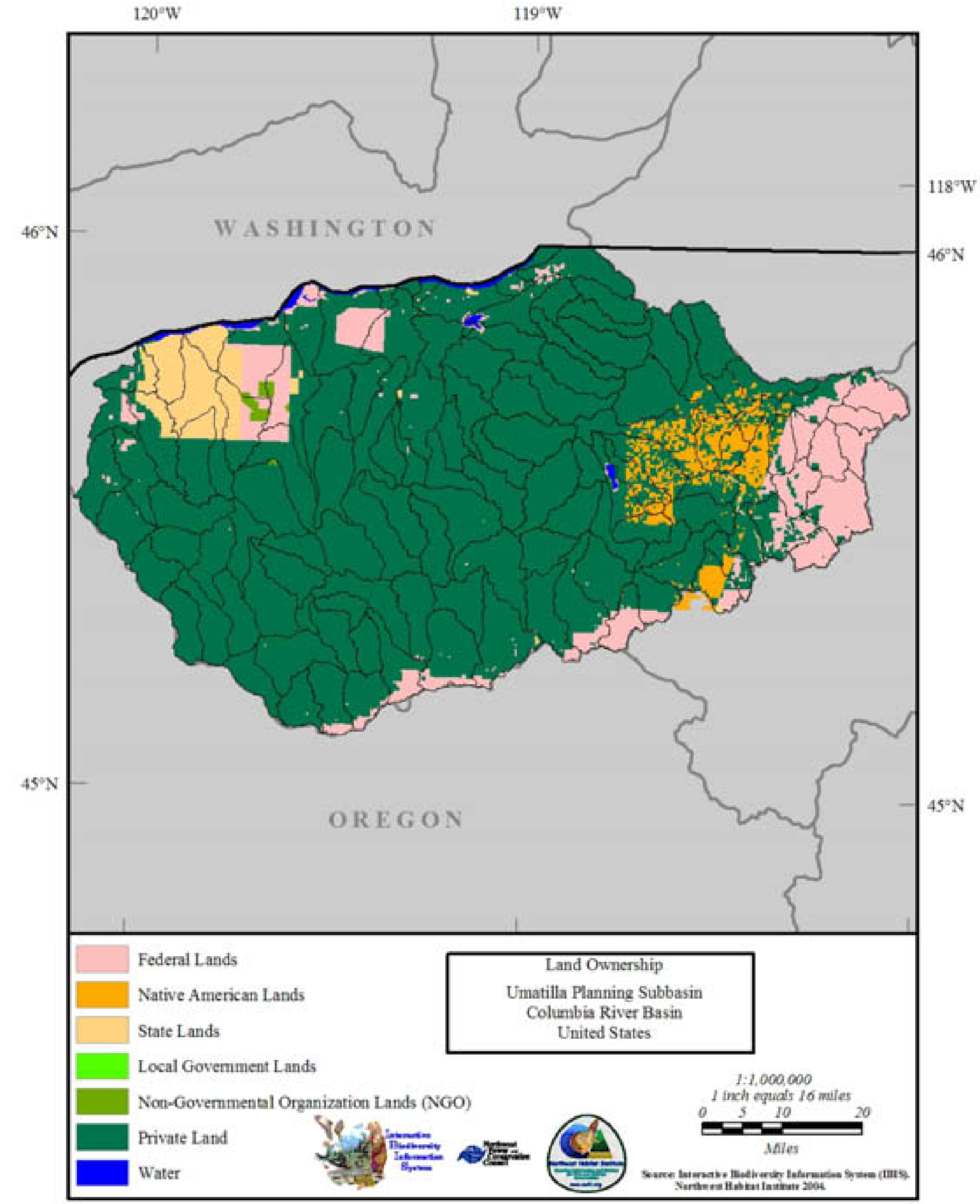

Figure 97. Ownership status of habitat found in the Umatilla/Willow subbasin (IBIS 2004).

Table 38. Estimated area of each habitat type under four different protection levels. Sources of data are denoted with superscripts.

Habitat Type:	**High Protection**	**Medium Protection**	**Low Protection**	**No Protection**
Mixed Conifer Forest[1]	12,788 acres (8%)	543 acres (<1%)	98,825 acres (59%)	55,143 acres (33%)
Ponderosa Pine[1]	3,504 acres (2%)	135 acres (<1%)	43,058 acres (27%)	115,559 acres (71%)
Western Juniper[1]	0 acres (0%)	18 acres (<1%)	525 acres (1%)	35,952 acres (99%)
Shrub-Steppe[2]				
Big Sage/Bluebunch Wheatgrass	49 (<1%)	124 (<1%)	9,200 (32%)	19,109 (67%)
Big Sagebrush Steppe	59 (<1%)	294 (<1%)	9,234 (21%)	33,499 (78%)
Bitterbrush	2,535 (6%)	8,609 (20%)	8,638 (20%)	23,670 (54%)
Rigid Sage/Sandberg Bluegrass	0 (0%)	5,468 (4%)	16,904 (14%)	102,467 (82%)
Interior Grassland[1]	3,964 acres (<1%)	0 acres (0%)	37,603 acres (7%)	486,702 acres (92%)
Herbaceous Wetlands[1]	657 acres (14%)	12 acres (<1%)	140 acres (3%)	3,861 acres (83%)
Riparian Wetlands[1,2,3,4]	(0%)	(2%)	(0-4%)	(94-98%)

1 IBIS 2004
2 Kagan et al. 2000
3 National Wetlands Inventory data
4 Adamus et al. 2002

Table 39. Land ownership of focal habitat types in the Umatilla/Willow subbasin. Sources of data are denoted with superscripts.

Habitat Type:	Federal Land	Native American Lands	State Lands	NGO Lands	Private Lands
Mixed Conifer Forest[1]	111,535 acres (67%)	11,661 acres (7%)	1,039 acres (<1%)	0 acres (0%)	43,065 acres (26%)
Ponderosa Pine[1]	45,648 (28%)	16,425 acres (10%)	825 acres (<1%)	0 acres (0%)	99,359 acres (61%)
Western Juniper[1]	525 (1%)	0 acres (0%)	18 acres (<1%)	0 acres (0%)	35,952 acres (99%)
Shrub-Steppe[2]					
Big Sagebrush Steppe	2,899 (7%)	272 (<1%)	57 (<1%)	6,733 (16%)	33,231 (77%)
Bitterbrush	13,751 (31%)	1,117 (3%)	0 (0%)	5,555 (13%)	23,529 (53%)
Rigid Sage/Sandberg Bluegrass	22,370 (18%)	502 (<1%)	25 (<1%)	0 (0%)	101,940 (82%)
Interior Grassland[1]	41,224 acres (8%)	54,430 acres (10%)	225 acres (<1%)	0 acres (0%)	432,390 acres (82%)
Herbaceous Wetlands[1]	768 acres (18%)	118 acres (3%)	260 acres (6%)	0 acres (0%)	3,229 acres (74%)
Riparian Wetlands[1,2,3,4]	(2-7%)	(1-64%)	(0-3%)	(0%)	(26-97%)

1 IBIS 2004
2 Kagan et al. 2000
3 National Wetlands Inventory data
4 Adamus et al. 2002

The following section describes the historic and current habitat distribution and protection and ownership status for each of the eight focal habitat types in the Umatilla/Willow subbasin. Detailed information about each of the focal habitat types, including descriptions of geographic range, vegetation, natural disturbance regimes, anthropogenic effects, and status and trends can be found in Appendix D. A discussion of limiting factors for each habitat is found in Section 3.5.2

INTERIOR MIXED CONIFER FOREST

As shown in Table 36 and Figure 98, the area of mixed conifer forest in the Umatilla/Willow subbasin has apparently doubled since historic times (c. 1850). However, planners believe that the quality of this habitat has declined, although no quantitative data on habitat quality (e.g., structure, species or seral diversity) of historic or current mixed conifer forest of the subbasin are available through assessment databases, such as IBIS. However, the maps shown in Figure 98 accurately depict the problem of fragmentation in this habitat.

As seen in Tables 38 and 39 and Figures 96, 97, and 98 most (>90%) of the mixed conifer habitat in Umatilla/Willow subbasin is under no or low protected status and most (67%) is federally owned.

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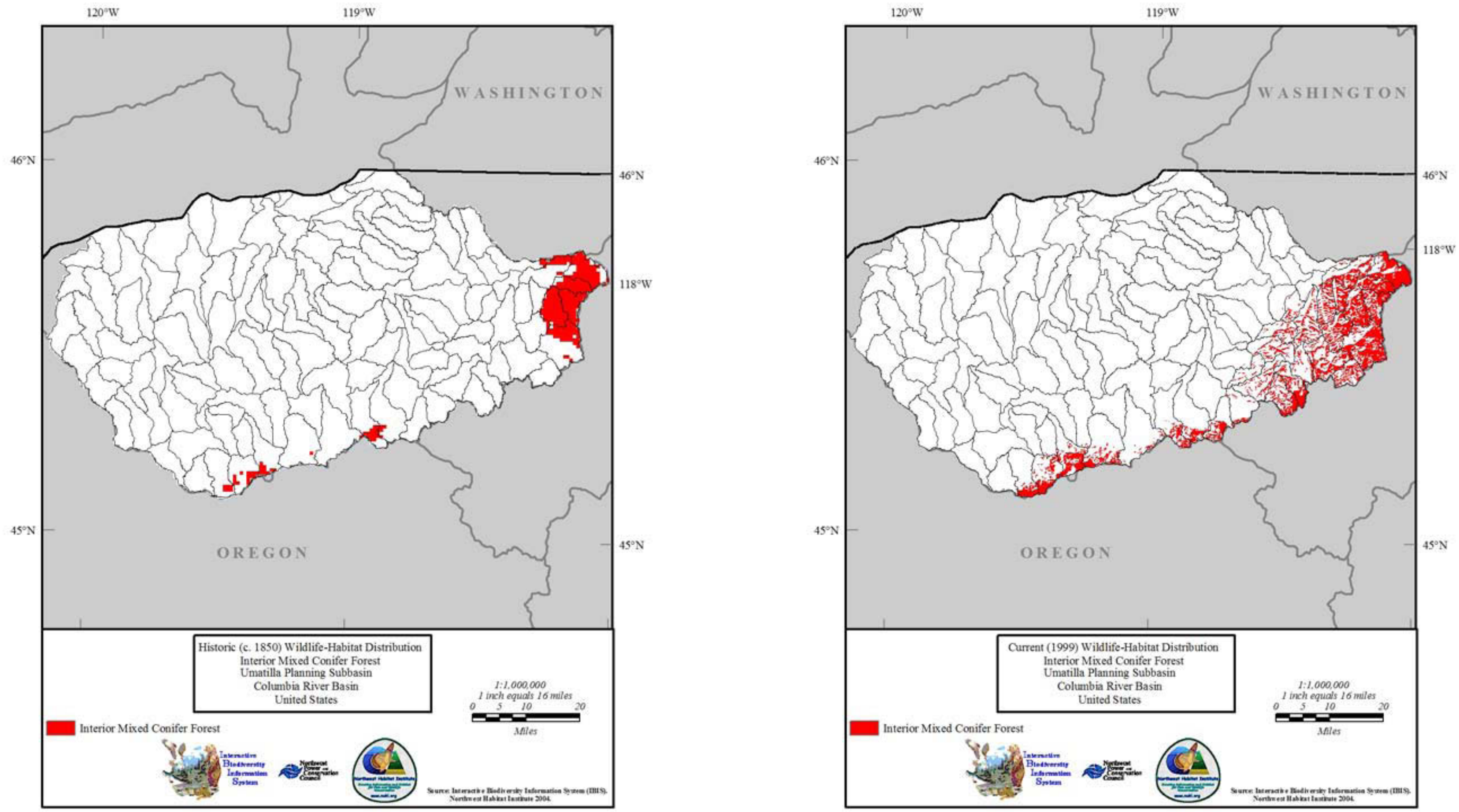

Figure 98. Historic (c. 1850) and current distribution (1999) of interior mixed conifer forest in the Umatilla/Willow subbasin (IBIS 2004).

PONDEROSA PINE FORESTS

As shown in Table 36 and Figure 99, the area of ponderosa pine forest in the Umatilla/Willow subbasin has apparently increased by over 10% since historic times (c. 1850). However, planners believe that the quality of this habitat has declined, although no quantitative data on habitat quality (e.g., structure, species or seral diversity) of historic or current ponderosa pine forest of the subbasin are available through assessment databases, such as IBIS. However, the maps shown in Figure 99 accurately depict the problem of fragmentation in this habitat.

As seen in Tables 38 and 39 and Figures 96, 97, and 99 most (98%) of the ponderosa pine habitat in Umatilla/Willow subbasin is under no or low protected status and most (61%) is privately owned.

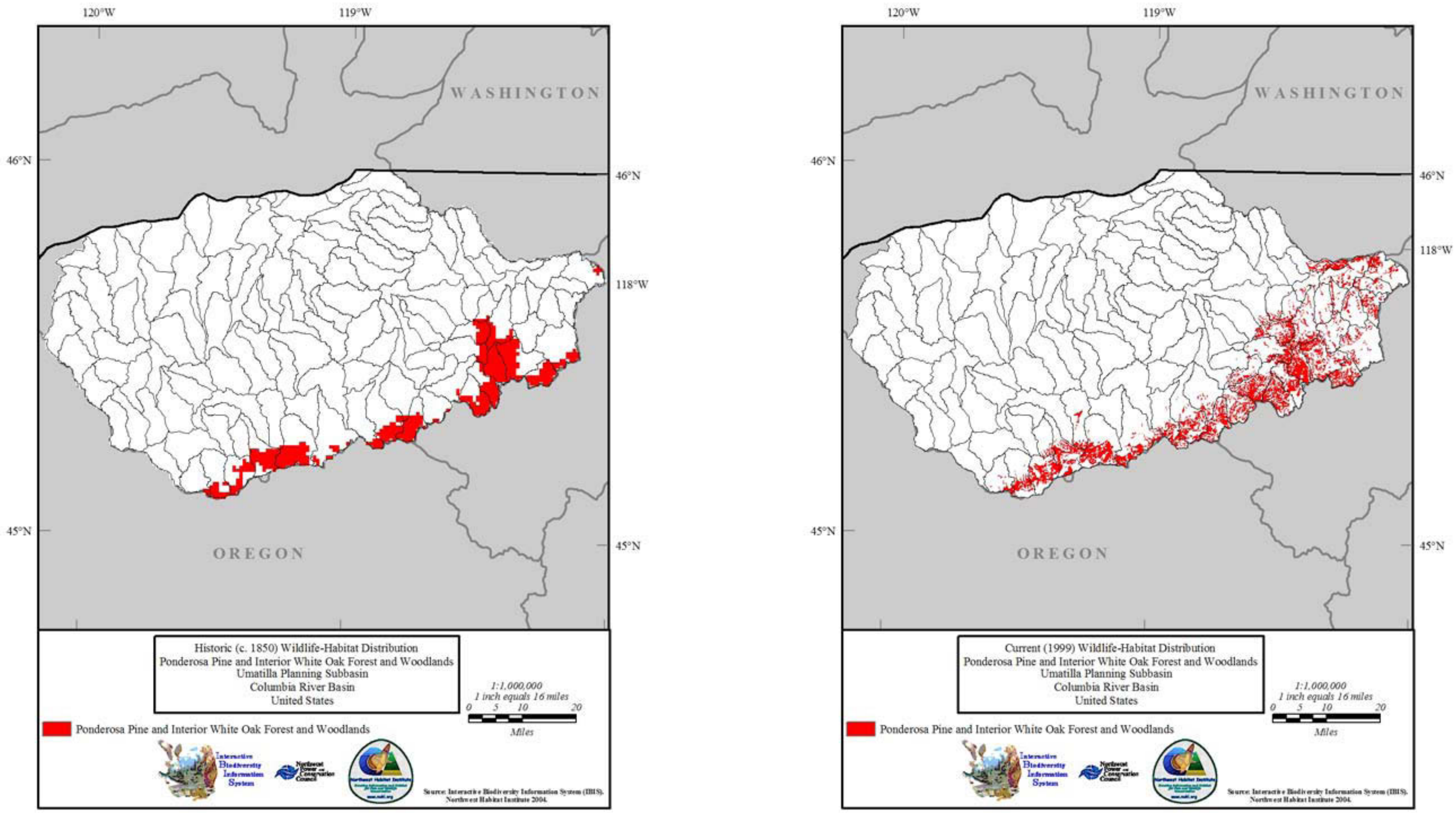

Figure 99. Historic (c. 1850) and current distribution (1999) of Ponderosa pine forests in the Umatilla/Willow subbasin (IBIS 2004).

QUAKING ASPEN FOREST

As shown in Table 36, the area of quaking aspen forest in the Umatilla/Willow subbasin has apparently decreased by 96% since historic times (c. 1850). The historical distribution of quaking aspen generated by IBIS is depicted in Figure 100; a map of current aspen distribution is not shown because of the limited habitat remaining. A recent study by CTUIR scientists provides additional data on both the potential historic distribution of aspen and its present distribution in a portion of the subbasin (Figures 101 and 102; Schumacher and O'Daniel 2004). Using a combination of field data and several spatial and statistical techniques, they determined that the current acreage in the study area was approximately 32 acres and the potential historical distribution in the study area was estimated at 60 acres. By combining IBIS and CTUIR data, the present acreage of quaking aspen in the subbasin is probably at least 80 acres. Although no quantitative data on habitat quality of historic or current quaking aspen forest of the subbasin are available through assessment databases, such as IBIS, subbasin planners believe that much of the remaining habitat is degraded.

No data are available from IBIS or other sources on the ownership or protected status of the limited amount of quaking aspen habitat in the subbasin; subbasin planners believe that most of it is on CTUIR or federal lands with an uncertain protected status.

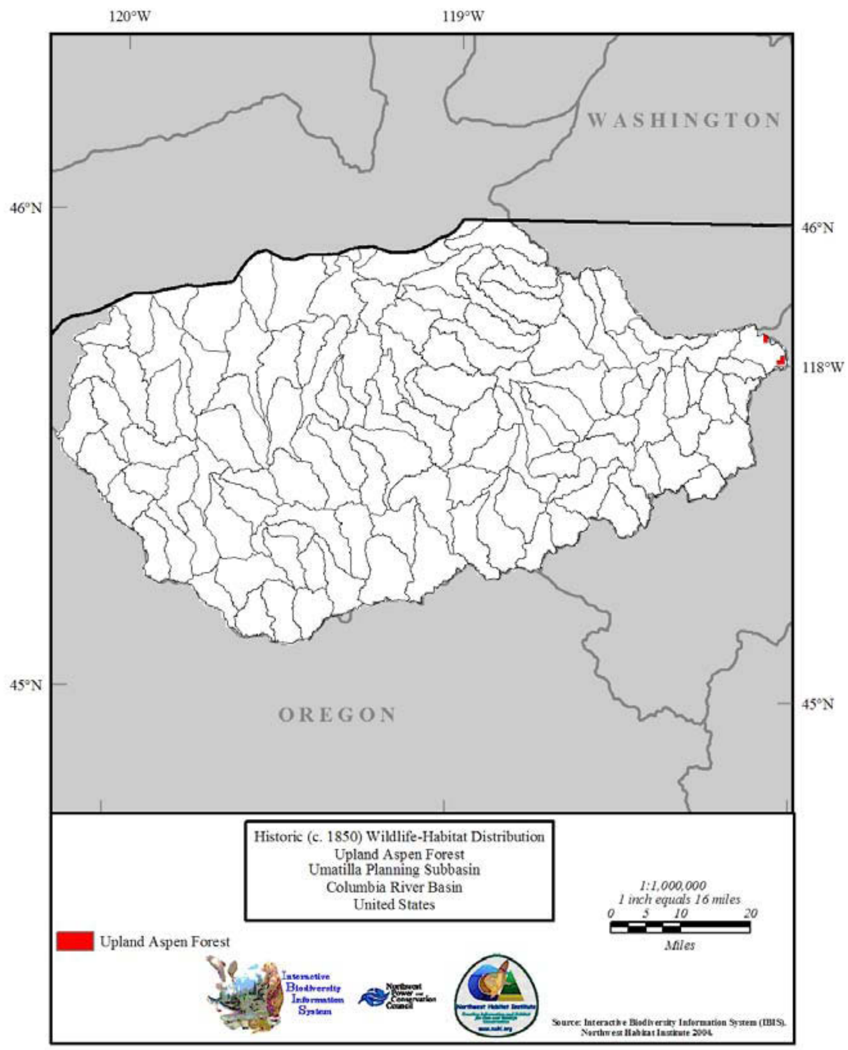

Figure 100. Historic (c. 1850) and current distribution (1999) of upland aspen forest in the Umatilla/Willow subbasin (IBIS 2004).

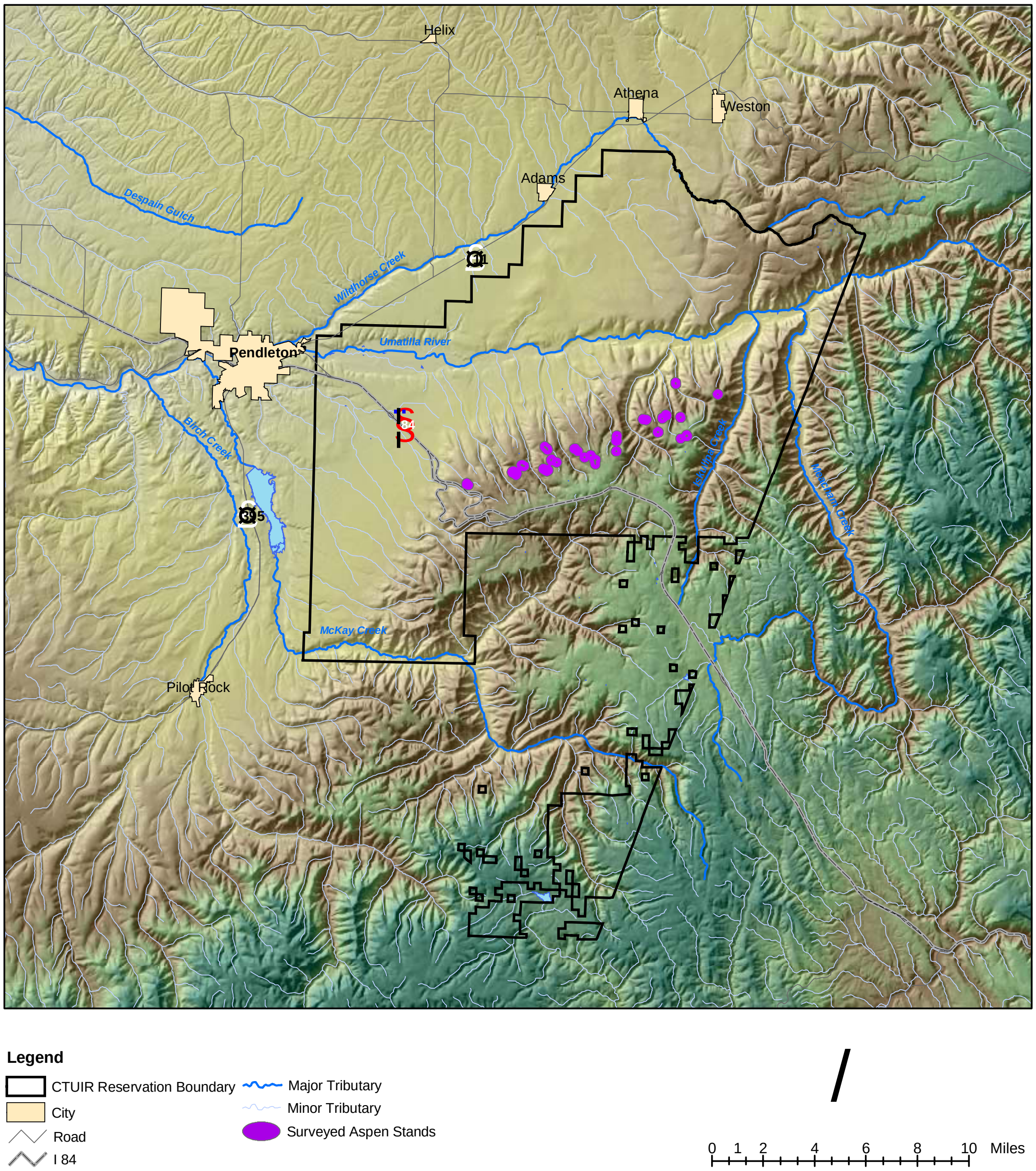

Figure 101. Surveyed aspen stands on the Umatilla Indian Reservation (map from Schumacher and O' Daniel 2004)

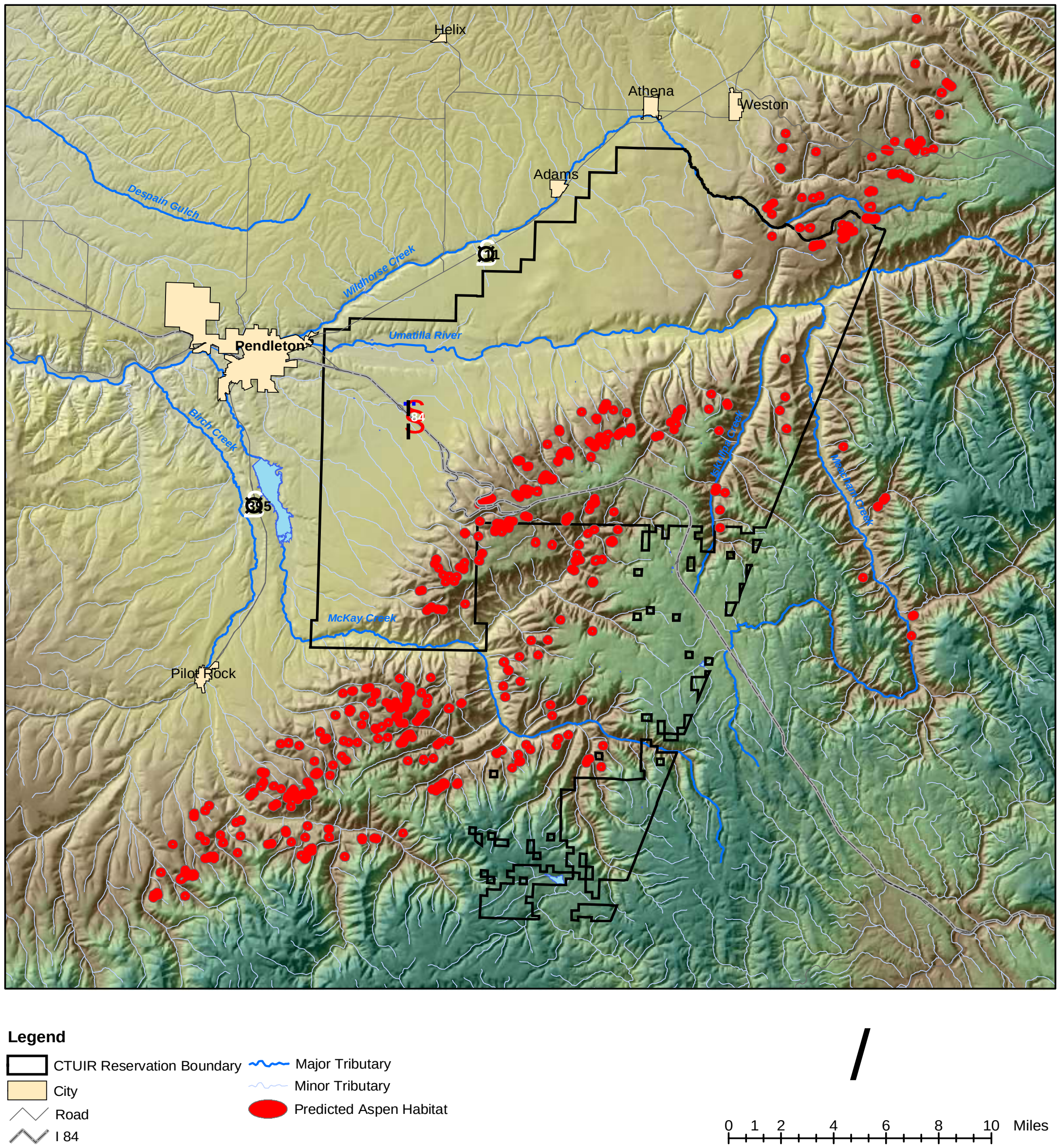

Figure 102. Predicted aspen habitat in the Umatilla Indian Reservation (map from Schumacher and O'Daniel 2004)

WESTERN JUNIPER WOODLANDS

As indicated in Table 36 and Figure 103, the area of western juniper woodland habitat in the Umatilla/Willow subbasin is estimated to have increased by over 1,000% since historic times (c. 1850) according to IBIS. However, planners believe the current acreage is overestimated. Juniper woodlands are found in two general areas of the subbasin: 1) on the foothills of the Blue Mountains in a mid-elevation transitional zone between ponderosa pine and grasslands/shrub-steppe habitats, and 2) as isolated trees or patches at lower elevations in shrub-steppe habitat. Unlike neighboring subbasins, such as the John Day subbasin, the invasion of juniper found in transitional zones into grasslands of the Umatilla/Willow subbasin is not a serious problem. Although the current distribution of mid-elevation transitional zone juniper woodland in the Umatilla/Willow subbasin compared to historical conditions is unclear, it has probably increased slightly or remained relatively constant. In contrast, juniper habitat associated with grassland and shrub-steppe are believed to be decreasing markedly, although the amount of that decline has not been well quantified because of the inability of past studies to map current juniper habitat using satellite imagery (Kagan et al. 2000). Juniper has always occurred sparsely in the western portions of the Umatilla Basin, and is still present in patches in many of the areas in which it was first seen by European settlers (Kagan et al. 2000). In these areas irrigated agriculture has been estimated to have resulted in the clearing of half to two-thirds of these stands, although important stands remain on the Boardman Bombing Range and in some canyons to the west.

As seen in Tables 38 and 39, and Figures 97, 98, and 103 virtually all of the western juniper habitat in Umatilla/Willow subbasin is under no or low protected status and most (99%) is privately owned.

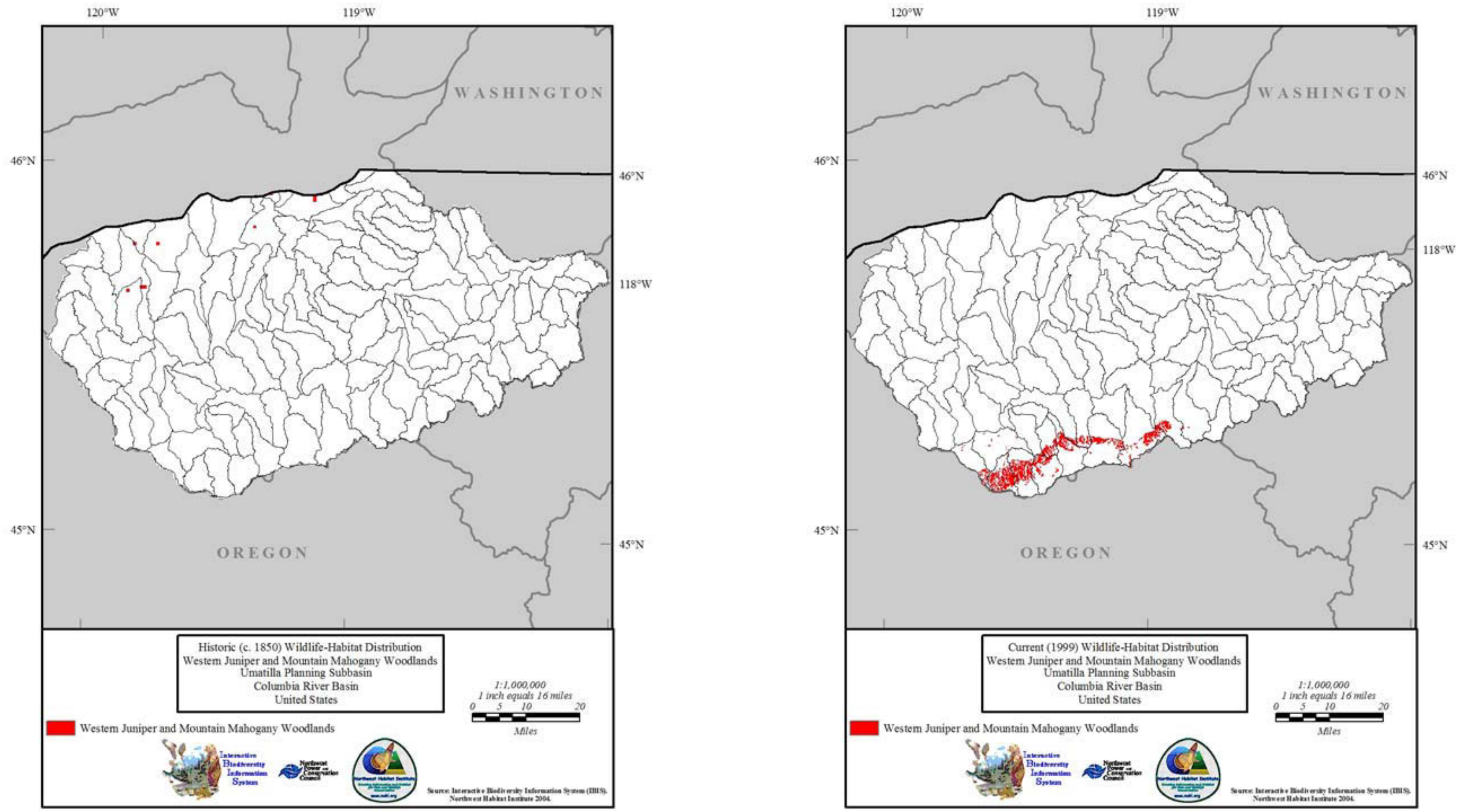

Figure 103. Historic (c. 1850) and current distribution (1999) of western juniper and mountain mahogany woodlands in the Umatilla/Willow subbasin (IBIS 2004).

SHRUB-STEPPE

Shrub-steppe habitat in the Umatilla/Willow subbasin is found both at low-elevations, where it occurs primarily on silt and sand loam soils of the lower subbasin, and at higher-elevations, where it is primarily associated with the foothills of the Blue Mountains. Figure 105 shows the historic and current distribution of shrub-steppe habitat in the Umatilla/Willow subbasin according to the IBIS database; this habitat type shows a dramatic increase (>100%) in the subbasin (Table 36). However, subbasin planners believe that large portions of the area depicted in Figure 105 is rabbitbrush associated with abandoned wheat fields that have been enrolled in CRP.

A more detailed and thorough study of shrub-steppe habitat was conducted by Kagan and colleagues (2000), who estimated historical and current distribution of specific types of shrub-steppe communities in a study area that included the majorioty of the Umatilla/Willow subbasin. They estimate that big sagebrush steppe has declined by 86% (Table 40), with most of this habitat loss occurring in the northern part of the subbasin on deeper loess soils, which are now farmed. Bitterbrush shrub-steppe, located primarily in the sandy areas of the northern part of the subbasin, has also experienced significant losses, with only 45% of the original habitat remaining (Kagen et al. 20000). The amount of higher-elevation shrub-steppe (rigid sage/sandberg bluegrass shrub-steppe) is believed not to have changed significantly since historic times and is currently estimated to be approximately 124,480 acres. The quality of both low and higher elevation shrub-steppe habitats is believed to have declined, although no quantitative data on habitat quality of historic or current shrub-steppe habitat of the subbasin are available.

Table 40. Estimated area (in acres) of historic (c. 1850) and current shrub-steppe habitat in the Umatilla/Willow subbasin.

Type of Shrub-Steppe	Historic Acreage	Current Acreage	Change in Acreage
Low Elevation Shrub-Steppe			
Big Sage/Bluebunch Wheatgrass	*	28,481	*
Big Sagebrush Steppe	302,951	43,085	-259,866 acres (-86%)
Bitterbrush	97,137	43,463	-53,674 acres (-55%)

* Not available

Protection and ownership status of shrub-steppe is shown in Tables 38 and 39. Kagan and colleagues identified five critical areas that not only contain a large portion of the existing low-elevation shrub-steppe habitat in the subbasin (up to 50%), but also the largest and highest quality remnants of low-elevation shrub-steppe. These areas are also significant because many of them have large portions of land that are owned or controlled by the federal government and TNC, which explains to some extent the patterns of ownership and protection status in low-elevation shrub-steppe evident in Tables 38 and 39. Each area is briefly described in Table 41.

Table 41. Description of five critical areas of shrub-steppe habitat in the Umatilla/Willow subbasin (from Kagen et al. 2000).

Critical Area	**General Description**
Horne Butte-Willow Creek	This area consists of BLM and adjacent private lands and includes high quality sagebrush habitat in the Willow Creek canyon. Its close proximity to the Boardman Bombing Range provides an important opportunity to restablish connectivity.
Boardman Bombing Range	The Boardman Bombing Range contains some of the best remaining examples of big sagebrush and bitterbrush habitat in Oregon. It includes the largest protected area in the lower Umatilla Basin – the Boardman Research Natural Area. The Nature Conservancy manages 4,750 acres on the Boardman Bombing Range.
Boeing Lease Lands	The property referred to as the Boeing Lease Lands is a 93,000 acre block of land owned by the state of Oregon, which was leased to the Boeing Company in 1963. No longer leased by Boeing, the area contains a small but very high quality bitterbrush remnant which may be the best example of this habitat in the world. The site also provides a connection between large blocks of habitat at the Boardman Bombing Range and habitat at Horne-Butte Willow Creek. The Nature Conservancy took over management of 22,642 acres of the former Boeing lease lands in 2001 and has begun developing long-term management and restoration plans for the property.
Umatilla Army Depot	The Umatilla Army Depot includes the largest remnants of Columbia Basin bitterbrush habitat.
Juniper Canyon	This is a small area, but represents the only remaining un-farmed area in the north-central portion of the Umatilla/Willow subbasin. It also contains unusual western Juniper and shrub habitats.

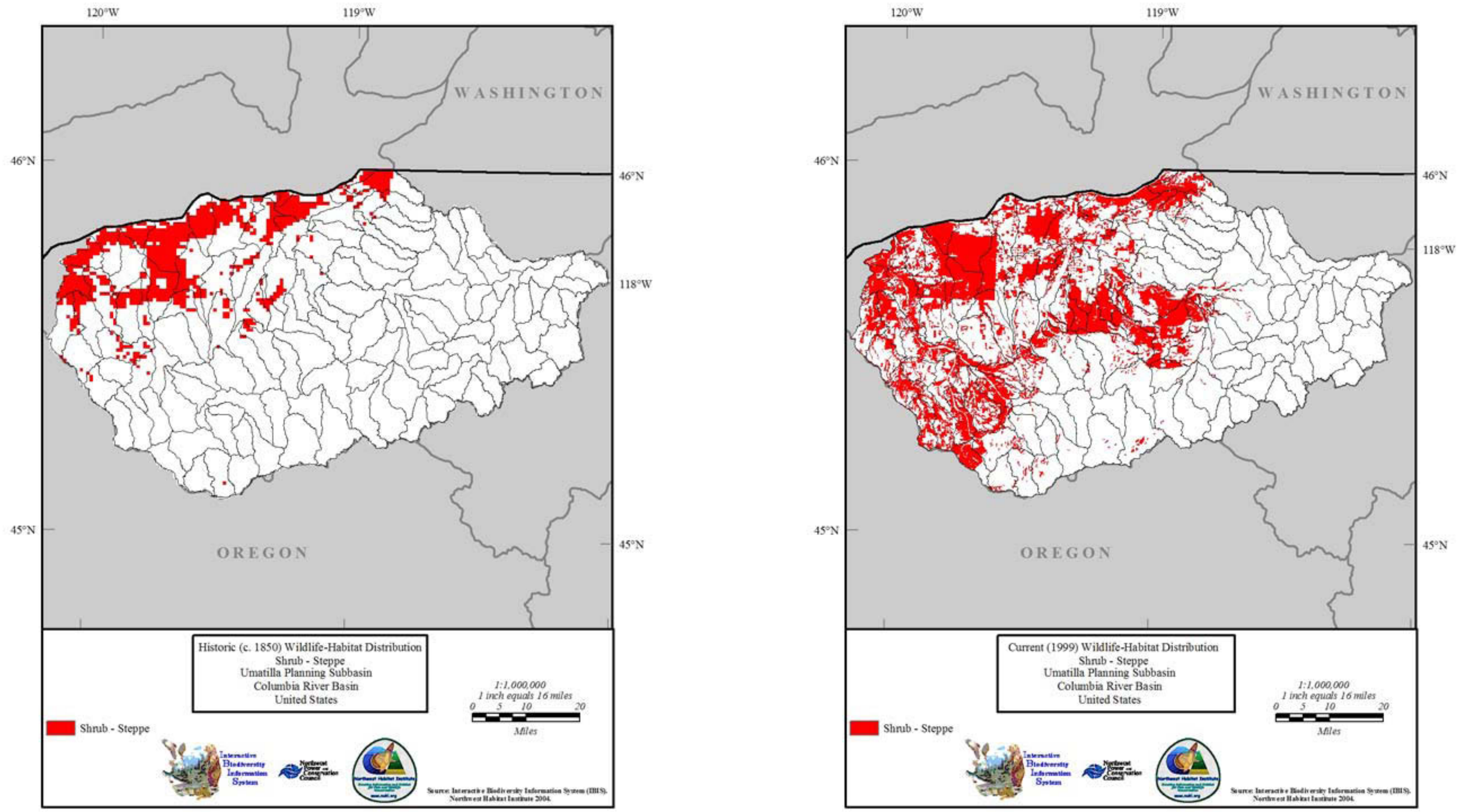

Figure 104. Historic (c. 1850) and current distribution (1999) of shrub-steppe habitat in the Umatilla/Willow subbasin (IBIS 2004).

EASTSIDE INTERIOR GRASSLANDS

As indicated in Table 36 and Figure 105, interior grasslands in the Umatilla/Willow subbasin are estimated to have declined by 74% since historic times (c. 1850). In addition, subbasin planners believe that the quality of remaining grassland habitat has also decreased, although no quantitative data on habitat quality of historic or current interior grasslands of the subbasin are available through assessment databases.

As seen in Tables 38 and 39 and Figures 96, 97, and 105, the vast majority (99%) of grassland habitat in the Umatilla/Willow subbasin is under no or low protected status and most (82%) is privately owned.

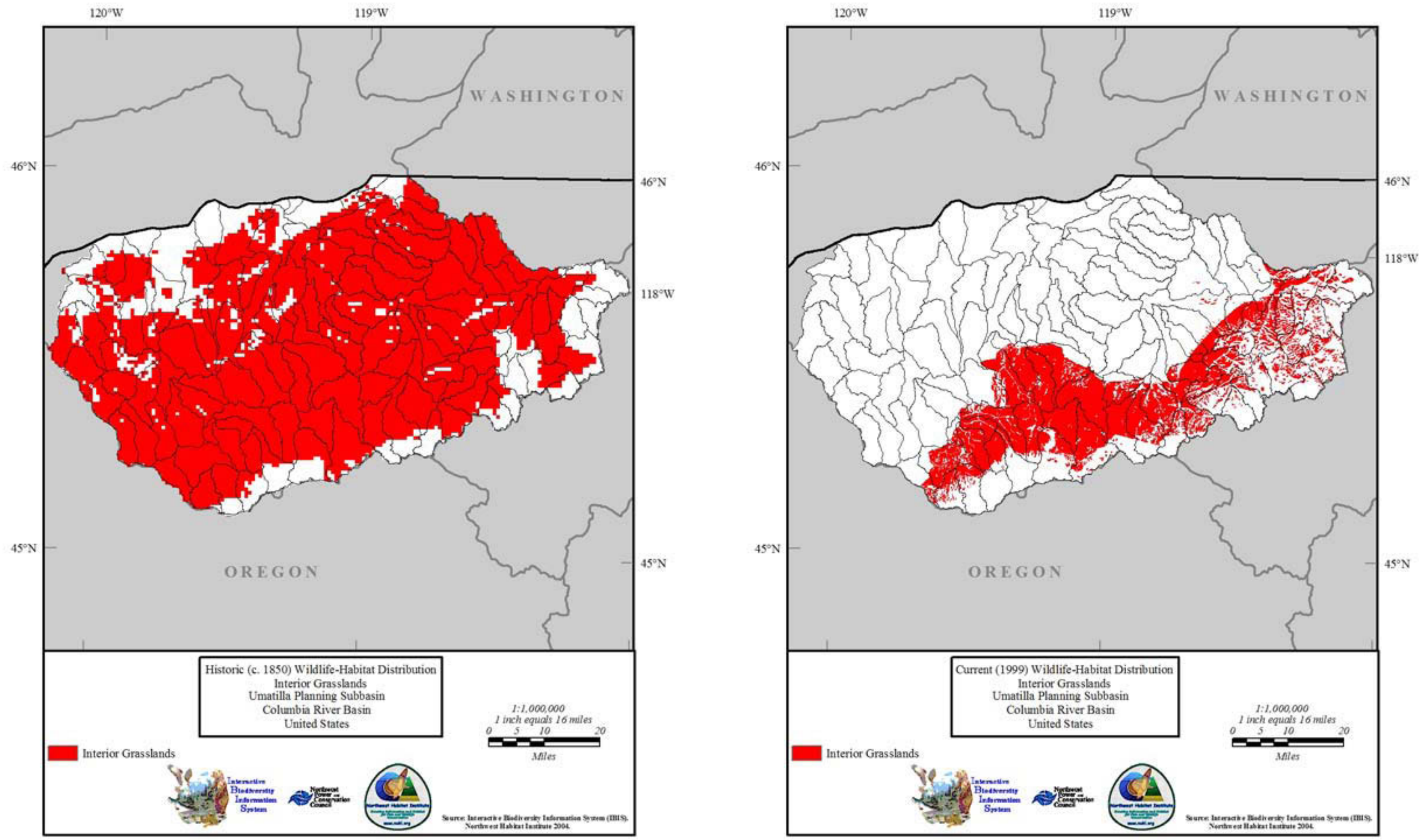

Figure 105. Historic (c. 1850) and current distribution (1999) of eastside interior grasslands found in the Umatilla/Willow subbasin (IBIS 2004).

HERBACEOUS WETLANDS

As indicated in Table 36 and Figure 106, the area of herbaceous wetland habitat in the Umatilla/Willow subbasin is estimated to have declined by 75% since historic times (c. 1850). Although data produced by IBIS is consistent with National Wetlands Inventory (NWI) data, a study conducted in the subbasin suggests that NWI maps may be inaccurate. According to Adamus and colleagues (2002) NWI maps are limited because they rely on aerial photos from July 1981 that have fairly coarse resolution. Also wetlands depicted on NWI do not necessarily meet federal land state jurisdictional criteria for wetlands. Regardless of the exact amount of herbaceous wetland in the subbasin, planners believe that the quality of that habitat has deteriorated, although no quantitative data on habitat quality of historic or current herbaceous wetland habitat of the subbasin are available.

As seen in Tables 38 and 39 and Figures 96, 97, and 106, most (86%) of the herbaceous wetland habitat in Umatilla/Willow subbasin is under no or low protected status and most (74%) is privately owned.

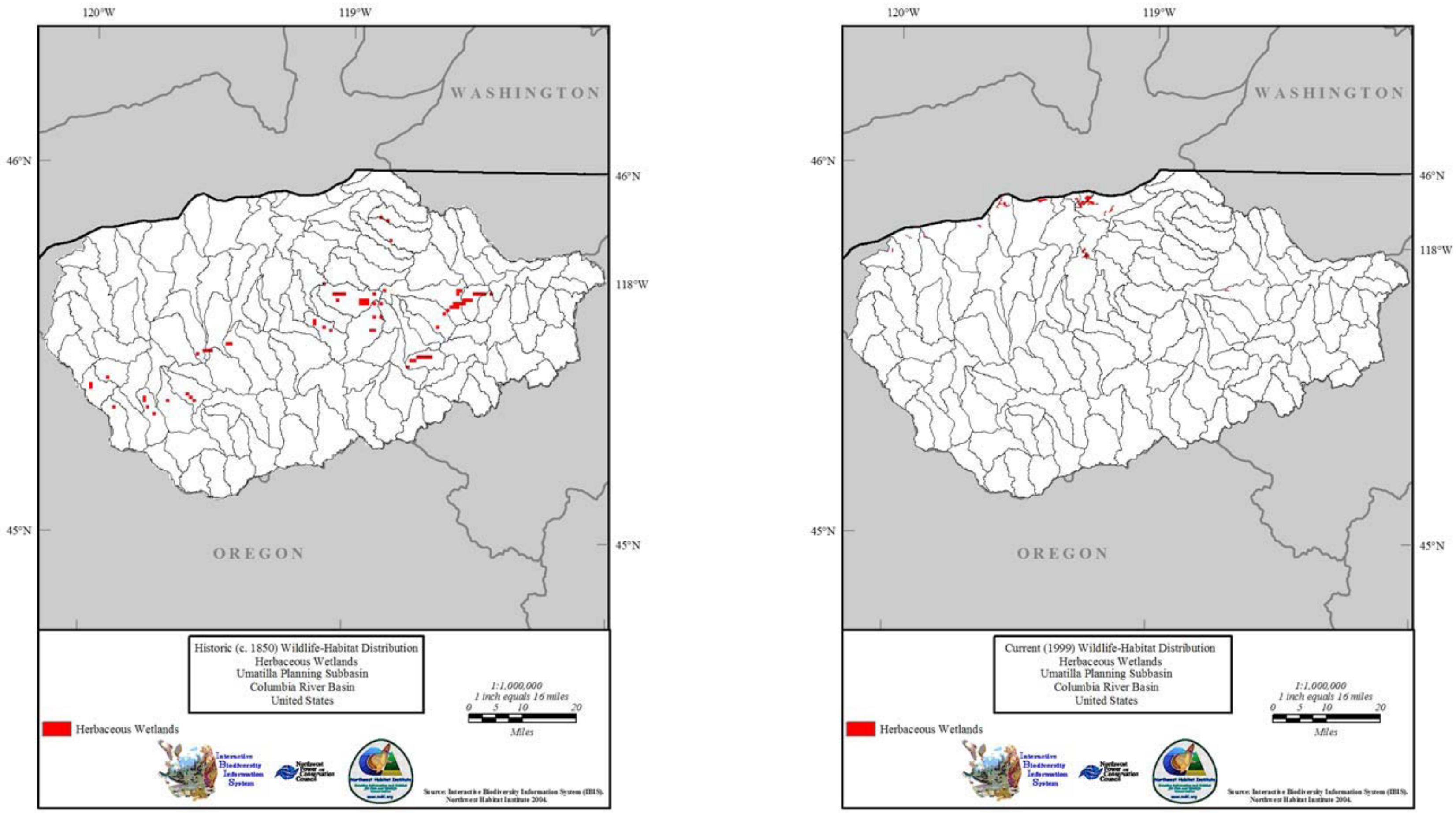

Figure 106. Historic (c. 1850) and current distribution (1999) of herbaceous wetlands in the Umatilla/Willow subbasin (IBIS 2004).

INTERIOR RIPARIAN WETLANDS

The amount of riparian wetland presently occurring in the Umatilla/Willow subbasin is uncertain. Data produced by IBIS suggesting that riparian wetlands have increased by over 900% are not accurate. However, the problem with IBIS data probably relates to underestimating the historical distribution of riparian wetlands. The current acreage of riparian wetlands estimated by IBIS (2,541 acres) is fairly consistent with estimates from other sources. For example, data from NWI estimate riparian wetland acreage in the Umatilla/Willow subbasin to be 1,137 acres, and Kagan et al. (2000) estimated riparian wetland acreage at 11,020 acres, although their study area included some areas outside the boundaries of the Umatilla/Willow subbasin. Regardless of the amount currently existing in the subbasin, the loss of riparian wetlands in the subbasin is estimated to have been severe. According to Kagan and colleagues (2000), riparian areas have shown a loss of 87%, which they believe to be an underestimate because the historical estimates were determined using information recorded by GLO surveyors, who only reported the largest riparian bottomland areas. Many thousands of acres dominated by willows with scattered alder and cottonwood were not reported, and therefore they suggest true losses probably exceeded 95%.

Several studies support the conclusion of subbasin planners that the quality of remaining riparian wetland habitats are poor (e.g., Watershed Professionals and Duck Creek Associates 2003, Wooster and DeBano 2003), although no quantitative data on historic riparian wetland habitat of the subbasin are available.

3.3 Out-of-Subbasin Effects

3.3.1 Aquatic

During the outmigration of smolts, ocean residency of growing subadults, and the spawning return of adults, salmon and steelhead encounter a variety of “out-of-subbasin” effects that negatively impact their populations. These effects include poor habitat in the Columbia River, the Columbia River estuary, and the ocean resulting from anthropogenic influences; dam passage, and harvest in both the Columbia River and the ocean. These effects are summarized briefly below.

The development of the federal hydropower system on the Columbia River has dramatically changed the habitat of the river from a free-flowing lotic system to a series of slow-flowing reservoirs. This change in flow as well as the need to navigate around dams has increased the passage time through the Columbia River of both outmigrating smolts and returning adults (NRC 1996). This increase in travel time has been identified as “…a key obstacle to survival of juvenile salmon and steelhead” (NRC 1996, pg. 243). With increased time spent in the reservoirs of the Columbia River comes an increase in mortality resulting from a variety of factors, including disease and predation (Raymond 1979, Rieman et al. 1991).

For salmon and steelhead of the Umatilla/Willow subbasin travel through the Columbia River also involves passing three hydroelectric dams (John Day, The Dalles, Bonneville). Dam passage is another source of significant mortality for both outmigrating juveniles and adults. Current estimates suggest that mortality at each facility is 4-5% (NRC 1996).

Before reaching the ocean, outmigrating juveniles pass through the Columbia River estuary. Estuaries are important environments for outmigrating juvenile salmon and steelhead. They provide abundant food resources and protected habitat (salt marshes and eelgrass beds) in which juveniles of some species (e.g., Chinook) grow considerably before entering the ocean (Steelquist 1992). Hydropower development has greatly affected the Columbia River estuary. By altering the Columbia River hydrograph less sediment is delivered to the estuary, the residence time of freshwater has increased resulting in reduced salinity, and there has been an increase in detritus in the estuary (NRC 1996). These changes have resulted in a loss of invertebrate productivity (the main food source for juvenile salmon) and a loss of protected habitat, which may result in increased mortality from predators (NRC 1996).

Upon reaching the ocean, salmon and steelhead populations are influenced by conditions found there. These conditions are greatly influenced by a recurring climatic pattern called the Pacific Decadal Oscillation (PDO) (Taylor and Southards 2003). TOAST (2004) summarized the impacts of the PDO on Columbia River salmon and steelhead as follows:

> The Pacific Decadal Oscillation is a pan-Pacific, recurring pattern of ocean-atmospheric variability that alternates between climate regimes every 20-30 years (Hare et al. 1999). The PDO affects water temperatures off the coast of Oregon and Washington and has cold (negative) and warm (positive) phases (Hare et al. 1999). A positive PDO phase brings warmer water to the eastern North Pacific, reducing upwelling of nutrient-rich cooler water off the coast of North America and decreasing juvenile salmon survival (Hare et al. 1999). The negative phase of the PDO has the opposite effect, tending to increase salmon survival.
>
> Climatic changes are manifested in both returns and harvest. Mantua et al. (1997) found evidence of an inverse relationship between harvests in Alaska and off the coast of Oregon and Washington. The negative phase of the PDO resulted in larger harvests of Columbia River stocks and lower harvests of Alaskan stocks. In the positive phase, warmer water resulted in lower harvests (and runs) in the Columbia River, but higher harvests in Alaska. Phase reversals occurred around 1925, 1947, 1977, and possibly 1999. The periods from 1925-1947 and from 1977-1999 were periods of low returns to the Columbia River, while periods from 1947-1977 and the current period are periods of high returns.

Finally, Umatilla/Willow subbasin salmon and steelhead populations are also influenced by out-of-subbasin harvest, both in the Columbia River and in the ocean. This harvest is summarized in a report by WDFW and ODFW (2002).

The total impact on an anadromous fish population of all of these out-of-subbasin effects can be aggregated into a single value, the smolt-to-adult survival or SAS. The SAS is calculated by dividing the total number of adults that return for a given brood year by the estimate of the number of smolts that left the subbasin for that brood year. In the Umatilla/Willow subbasin these data are available for hatchery and naturally produced summer steelhead and spring Chinook and for hatchery reared fall Chinook (Table 42).

Table 42. Estimates of out-of-subbasin effects on anadromous salmonid populations in the Umatilla/Willow subbasin. This estimate is the percentage of smolts that return as adults (SAS) for hatchery production and natural production. Data from Chess et al. (2003).

Brood Year	Steelhead		Spring Chinook		Fall Chinook
	Hatchery SAS	Natural SAS	Hatchery SAS	Natural SAS	Hatchery SAS
1991	0.110 %		0.117 %		
1992	0.413 %		0.306 %		
1993	0.543 %		0.376 %		
1994	0.928 %		0.003 %		
1995	0.374 %		1.009 %		
1996	0.302 %	5.2 %	0.400 %	3.2 %	0.020 %
1997	0.281 %	2.7 %		1.6%	0.004 %
Average	**0.422 %**	**3.95 %**	**0.369 %**	**2.4 %**	**0.012 %**

These estimates reveal that a very large proportion of these populations are lost resulting from out-of-subbasin impacts. In addition, while the data for naturally produced fish is limited, it appears that their out-of-subbasin survival is much higher than hatchery produced fish. Measurements of the survival of hatchery and naturally produced outmigrating smolts released from Three Mile Falls Dam (RM 3.7) and an ODFW trap to the John Day Dam on the Columbia River indicate that even after that brief period out of the subbasin, hatchery produced fish (of both steelhead and Chinook) are already surviving at a lower rate than naturally produced fish (Table 43) (Ackerman et al. 2003).

Table 43. Survival rate of hatchery and natural steelhead and Chinook smolts from near the mouth of the Umatilla River to the John Day Dam. Data from Ackerman et al. 2003.

Migration Year	Rear Type	Number Released	Estimated Survivors to John Day Dam	Estimated Survival Rate
		Steelhead		
1999	Natural	1830	1427	0.780
	Hatchery	1508	1102	0.731
2001	Natural	281	99	0.354
	Hatchery	329	77	0.235
		Chinook		
1999	Natural	653	560	0.858
	Hatchery	1104	404	0.366

It is unclear why the survival of hatchery reared fish is so much lower than that of naturally produced fish. Several factors are most likely responsible for this including high levels of stress in hatchery fish, inappropriate behavior resulting from hatchery rearing and predation. For example, tern predation on outmigrating smolts in the Columbia River estuary has recently received attention because of the large number of terns that have colonized Rice island, a man-made island formed from dredge spoil. Work by Collis et al. (2001) revealed that hatchery reared steelhead and Chinook were more vulnerable than naturally produced fish of both species to tern predation in the estuary. The authors attribute this to differences in the behavior of hatchery and wild fish -- hatchery fish spend more time near the water surface where terns forage, and this behavior most likely results from the manner in which they were fed in hatcheries (with floating food pellets).

The estimates of out-of-subbasin survival in Table 42 illuminate the need to improve out-of-subbasin conditions to enhance adult returns to the subbasin. However, within-subbasin survival is obviously also an important issue. Within-subbasin survival has been estimated for hatchery spring Chinook outmigrating smolts and for adults from passage at TMFD to spawning (Table 44).

By comparing Table 42 and 44, it is obvious that out-of-subbasin survival for spring Chinook is much lower than survival within the subbasin. This is not surprising given the fact that the Umatilla/Willow subbasin represents only a tiny fraction of the total habitat used by spring Chinook throughout their life cycle and the very brief period of time that the spring Chinook, for which we have within-subbasin survival estimates, spend in the subbasin (particularly given that the juvenile survival estimate is for hatchery releases smolts that immediately start to outmigrate once they are released). However, these estimates of within-subbasin survival also reveal that there is much room for improvement for survival within the subbasin. In addition, these estimates of within-subbasin survival reveal an important data gap: accurate estimates of the survival of naturally produced fish from the egg stage to outmigrating smolts. This is a critical time at which within-subbasin survival might be very low given the poor habitat conditions and high water temperatures characteristic throughout much of the subbasin.

Table 44. Estimates of within-subbasin survival for spring Chinook. Data for smolt survival from Chess et al. (2003) and data for adult survival from Kissner (2003).

Year	Hatchery Smolt Survival[a]	Adult Surival to Spawning[b]
1991	Not Calculated	23.6%
1992	Not Calculated	29.3%
1993	Not Caclulated	42.9%
1994	Not Calculated	52.3%
1995	Not Caclulated	41.0%
1996	34%	32.5%
1997	Not Applicable[c]	35.9%
1998	104%	43.0%
1999	81%	45.3%
2000	95%	43.1%
2001	18%	28.1%
2002	Not Available	32.0%
Average	**66.4%**	**37.4%**

a Smolts were released in the Umatilla River mainstem at RM 79.5 and collected at RM 3.7 in 1996 and RM 1.2 in 1998-2001. Survival was calculated by dividing the estimated number of hatchery smolts passing the trap location by the known number of hatchery smolts released at RM 79.5. Data from Chess et al. (2003).
b The percent of the adults surviving to spawning was calculated as the percent of total adult carcasses found that had spawned. Estimates are for natural and hatchery fish combined. Data from Kissner (2003).
c In 1997 ODFW changed their smolt trapping methodology from the use of an irrigation canal bypass trap to the use of rotary screw traps. However, a reasonable estimation of the proportion of smolts captured using rotary screw traps was not developed until 1998. Therefore, the outmigrating smolt numbers for 1997 are considered inaccurate and were not used to calculate smolt survival.

3.3.2 Terrestrial

As with aquatic species, out-of-subbasin effects will be of concern for migratory species or species with large home ranges that may span two or more subbasins. Only five of the Umatilla/Willow subbasin's focal species are known to migrate: the Great Blue Heron, the Yellow Warbler, the Red-naped Sapsucker, the Sage Sparrow, and the Grasshopper Sparrow. Very little is known about the magnitude of out-of-subbasin effects for any of these species, although some generalizations can be made. Habitat destruction and degradation along the migratory route, as well as in the wintering location, may negatively impact some species. However, subbasin planners believe that focal species populations in the subbasin are primarily limited by factors operating within the subbasin rather than factors operating outside of the subbasin, at least to the point that habitat improvements undertaken within the subbasin are predicted to result in increases in focal species populations.

Ashley and Stoval (2004) describe some of the factors that may negatively affect the five migratory species outside of the subbasin (Ashley and Stoval, 2004)

Great Blue Heron
Great Blue Heron may be affected by poor water quality within their winter range. Poor water quality can negatively affect the species by 1) reducing the amount of large fish and invertebrate species available in wetland areas, and 2) introducing toxic chemicals into the food chain, where they accumulate in the tissues of prey and may eventually cause reproductive failure in the herons.

Yellow Warbler
Poor riparian habitat and increased pesticide use are two negative effects Yellow Warblers may encounter as they migrate. Increased pesticide use in the metropolitan areas, especially with the outbreak of mosquito born viruses like West Nile Virus, may impact food availability.

Red-naped Sapsucker
Migrating Red-naped Sapsuckers may have an increased probability of hybridizing with Red-breasted Sapsuckers and Yellow-bellied Sapsuckers where distributions overlap.

Sage Sparrow and Grasshopper Sparrow
Both species are especially vulnerable to loss and fragmentation of shrub steppe habitat throughout their respective travel corridors.

3.4 Environment/Population Relationships

3.4.1 Aquatic

All focal species in the Umatilla/Willow subbasin and the taxa of interest (lamprey and mussels) require cold water free of pollutants (Close et al. 1995; McMahon 1991; NRC 1996). In addition, they require substrate that is complex and contains both areas that are a gravel-cobble complex with little fine sediment as well as depositional areas with higher amounts of coarse sediment. Sediment-free substrate provides the appropriate habitat for spawning by steelhead, salmon, and bull trout as well as appropriate habitat for rearing of fingerlings (Buchanan et al. 1997; NRC 1996); while areas that include coarse sediment are important spawning sites for lamprey (Close et al. 1995). Depositional areas are important because they act as nutrient traps, preventing both allochthonous material (i.e., material derived from the riparian zone) and salmon carcasses (an important source of nutrients to streams) from simply being flushed out of the system during high flow events (Bisson and Bilby 1998). Finally, the focal species also require abundant habitat that includes structure or complexity. This complexity provides cover from predators and high flows (Reinhardt and Healey 1997; Swales et al. 1988).

Perhaps two of the most important ecosystem factors that affect the quality of habitat for the focal species in the Umatilla/Willow subbasin are adequate flows and a properly functioning riparian area. Low flows are a particular problem in the lower and middle reaches of both Willow Creek and the Umatilla River during the summer. Low flows combined with passage barriers have eliminated anadromous steelhead from Willow Creek. Low flows in the lower Umatilla river help create high temperatures that are limiting to focal species (see Section 3.5). However, efforts to enhance flow, especially in the lower Umatilla River, have already begun and plans have been developed to continue these efforts through Phase III of the Umatilla Basin Project (see Section 3.1.3.2). Restoration of adequate flows in the subbasin will enhance populations of the focal species by decreasing water temperatures, increasing the amount of habitat, and flushing sediment from the system.

Riparian vegetation losses have been extensive throughout the subbasin; for example, Kagan et al. (2000) estimate that the lower and mid Umatilla/Willow subbasin has lost over 90% of its historic coverage of riparian areas. Riparian areas can greatly decrease water temperatures by shading streams and enhancing the exchange of surface water and ground water (NRC 2002). Riparian areas decrease water pollutants and sediment input by filtering overland flow that includes runoff from agricultural and urban lands that can be high in sediment and certain types of pollutants (Peterjohn and Correll 1984). Finally, riparian areas add greatly to the habitat complexity of stream reaches because they are the source of large woody debris (NRC 2002). Large woody debris adds to the habitat complexity of stream reaches by directly providing cover for fish and other aquatic organisms and indirectly by influencing the geomorphology of streams (influencing channel width, stabilizing gravel bars, and creating pools) (Bilby and Bisson 1998).

More information on the environmental needs of the focal species and taxa of interest can be found in Sections 3.1.1.9, 3.1.3.2, and 3.2.3. In addition, the environmental factors limiting populations are discussed in Section 3.5.1 and strategies designed to ameliorate those impacts are outlined in Section 5.1.

3.4.2 Terrestrial Wildlife Environment and Population Relationships

This section describes the relationship between environmental factors and populations of focal species for each of the eight focal habitat types in the Umatilla/Willow subbasin. It begins with a discussion of preliminary efforts to use habitat condition to map suitability for six focal species. The effort was partially successful for some species. The next section describes the specific key environmental correlates for focal species and other species with a close association with the focal habitat. The section ends with information about functional redundancy.

3.4.2.1 Habitat Suitability

The following maps of habitat suitability were generated by ONHP. The following description was provided by E. Gaines at ONHP (personal communication: May 2004) explaining the process used to generate the maps:

> Species suitability maps were generated using several different data layers.
>
> A hexagon data set, last updated in 2002, showed species presence in each of 441 equal-area hexagons. The hexagons were originally developed for the Environmental Monitoring and Assessment Program (EMAP) of the US EPA. These hexagon distribution maps are a very coarse first filter, and have been reviewed by experts for each species group.
>
> For this project, we overlaid the hexagon distribution maps with sixth field watersheds. This resulted in suitability maps with more 'natural' looking boundaries (watershed boundaries as opposed to hexagon boundaries). These are smaller areas, so can be used to better confine a species distribution. For each watershed, species were assigned a value (primarily from the hexagon data set):
>
> C (Confident) – 95% confident that the species occurs in the watershed (based on a specimen or confirmed observation.
>
> P (Probable) – 80-95% confident that the species occurs in the watershed.
>
> ? (Possible) – 20-75% confident that the species occurs in the watershed
>
> For the distribution maps, we used all watersheds that were either confident or probable (C or P)
>
> A revised vegetation map was put together with 30 meter pixel resolution and using the NatureServe Ecological System Classification. The vegetation map was crosswalked to a wildlife habitats map with 59 habitat types.
>
> Wildlife Habitats Relationships matrices (WHR) were created for each ecoregion. For each species, each habitat's suitability within the ecoregion was scored from 0 to 6, as follows:

0	Seldom or never used habitat
1	Unsuitable habitat infrequently used
2	Poor potential habitat
3	Mediocre potential habitat
4	Good potential habitat
5	High quality potential habitat

To create the species suitability maps, we intersected the habitat map with the watershed-based distribution map. The WHR was used identify those habitats where the species could be expected to be found, and the watershed occurrence limits the predicted distribution to only the regions where species have a confirmed or probable occurrence. To minimize confusion, in most cases we will only show those habitats where the suitability ranking was 3 or higher (mediocre or better).

Each map is presented below with a brief discussion of the subbasin wildlife managers' judgment of the success of the map in illustrating potential habitat for the focal species.

Pileated Woodpecker: The habitat suitability map generated for the Pileated Woodpecker (Figure 107) was judged to be fairly accurate except that subbasin managers felt that the quality of the habitat was overestimated. Particularly, managers believe that habitat identified as good was moderate at best, especially along the western-most portion of the map.

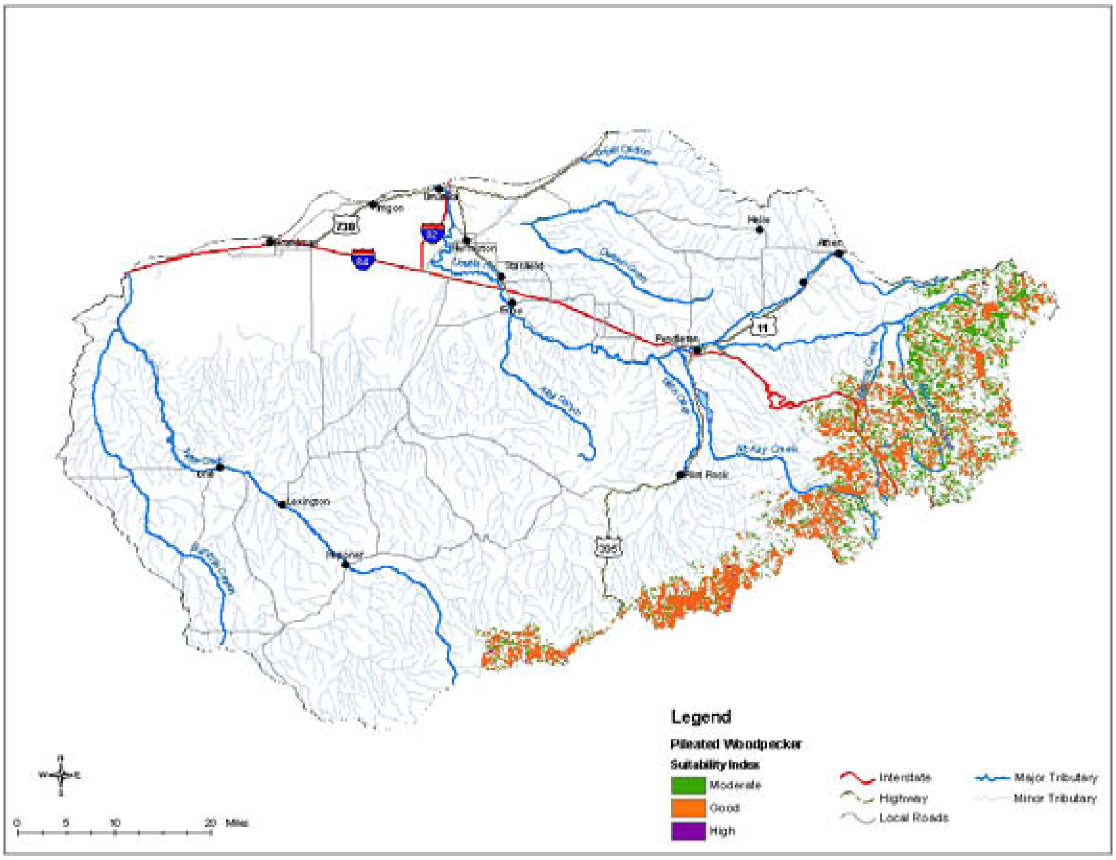

Figure 107. The distribution of potential habitat for the Pileated Woodpecker in the Umatilla/Willow subbasin as described by a suitability index.

White-headed Woodpecker: Subbasin managers believe that the map in Figure 108 vastly overestimates the suitability of habitat for the White-headed Woodpecker. Managers believe that only moderate quality habitat can be found in the subbasin, at best, and that even this is very rare.

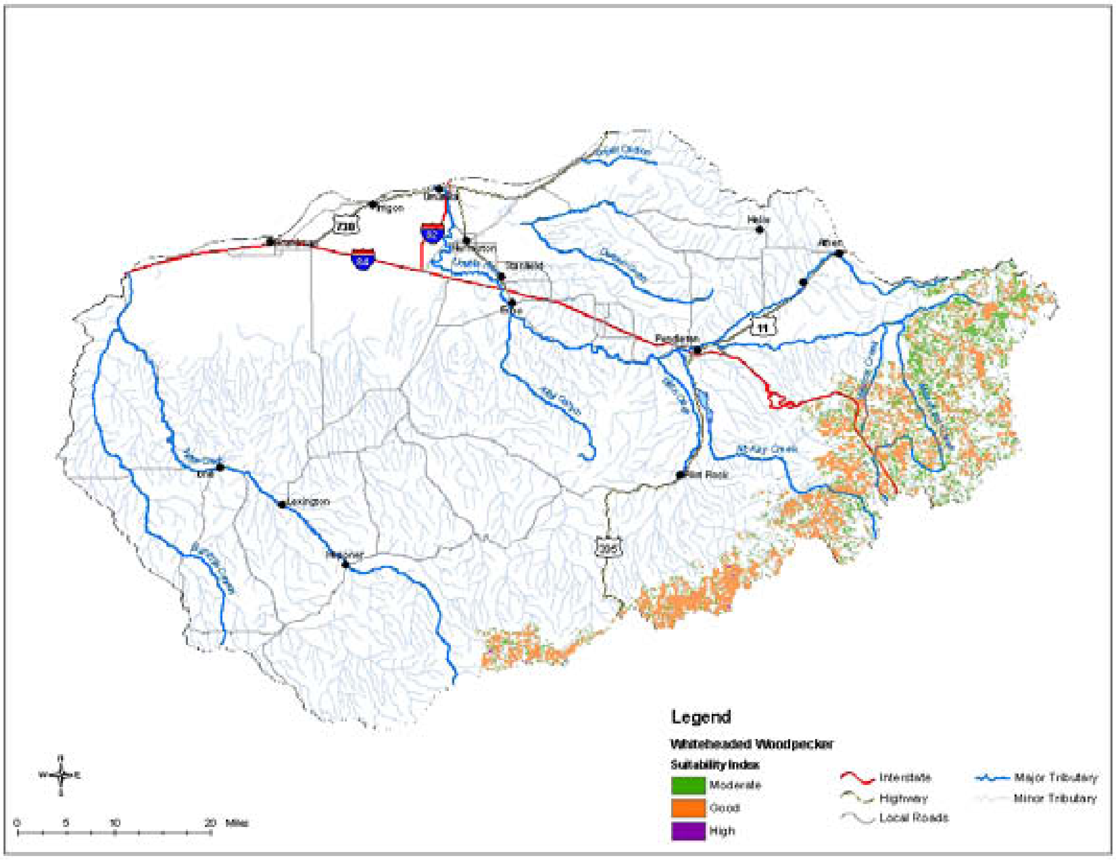

Figure 108. The distribution of potential habitat for the White-headed Woodpecker in the Umatilla/Willow subbasin as described by a suitability index.

Red-naped Sapsucker: Subbasin managers believe the map in Figure 109 vastly overestimates the amount of good and high quality habitat available for the Red-naped sapsucker. Given the rarity of aspen habitat and its importance to the Red-naped Sapsucker, managers believe that suitable habitat is much less than shown, and only of moderate quality, at best.

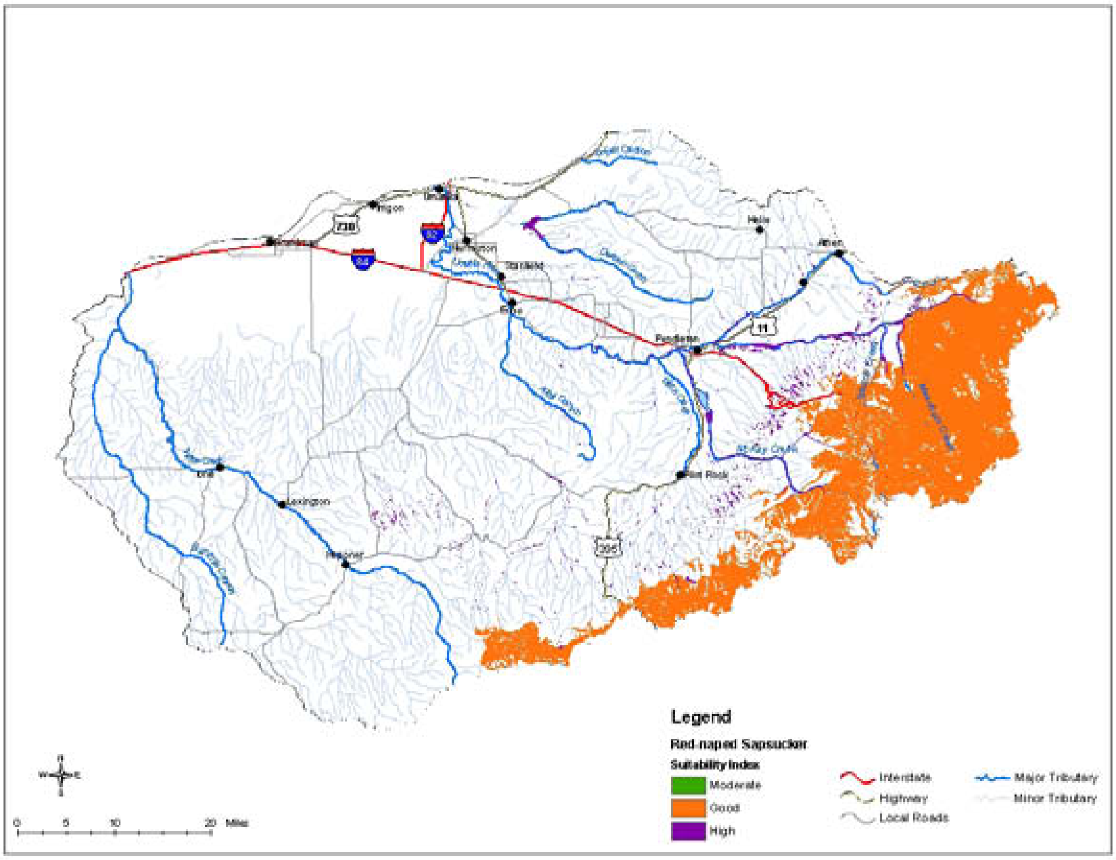

Figure 109. The distribution of potential habitat for the Red-naped Sapsucker in the Umatilla/Willow subbasin as described by a suitability index.

Ferruginous Hawk: The map generated for the Ferruginous Hawk (Figure 110) was deemed to be fairly accurate with the exception that no suitable habitat is shown in the western part of the subbasin. Managers believe that the same pattern seen in the eastern part of the subbasin applies to the western portion as well. Of areas that were mapped, managers only questioned the quality of habitats depicted east of Pendleton, especially that area in and around Hermiston; managers believe that the quality of this habitat is probably overestimated.

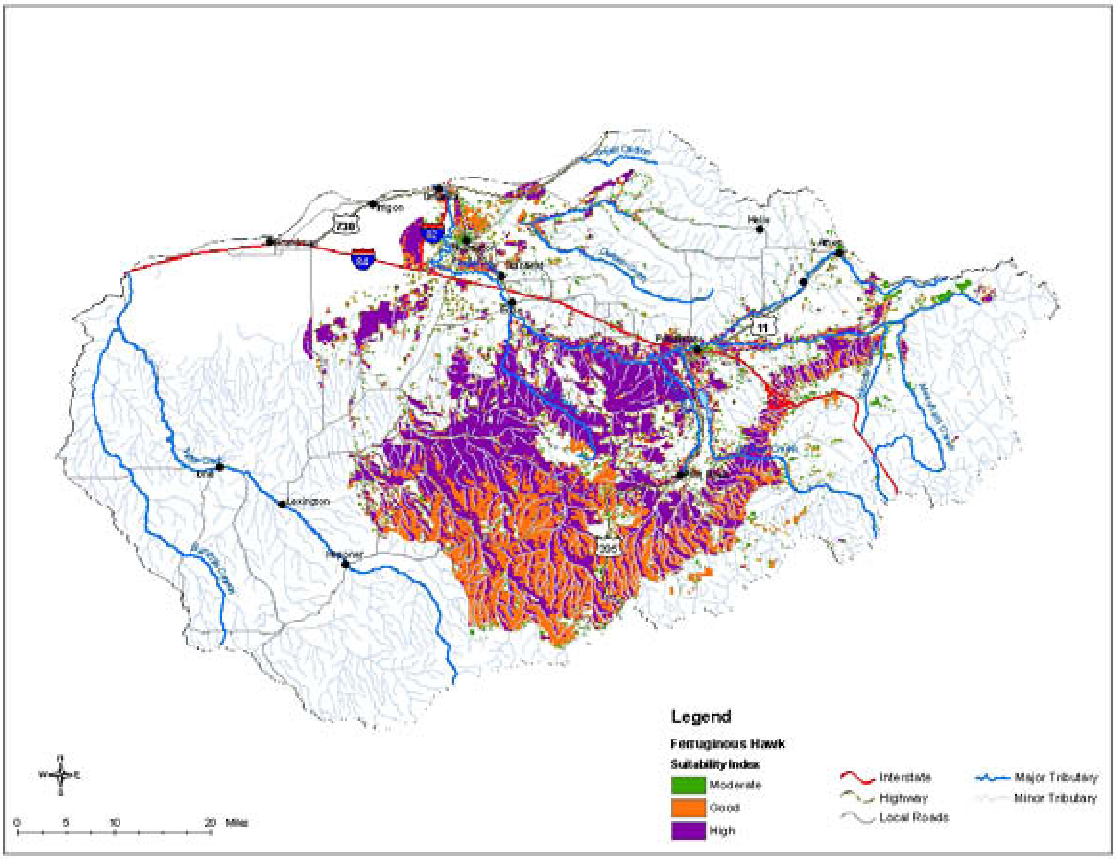

Figure 110. The distribution of potential habitat for the Ferruginous Hawk in the Umatilla/Willow subbasin as described by a suitability index.

Sage Sparrow: The map generated for Sage Sparrow is believed to be very inaccurate. Many of the areas that are shown as being highly suitable for the Sage Sparrow are small areas between irrigated crop circles, which are not considered to be viable Sage Sparrow habitat at all. In addition, other areas known to be

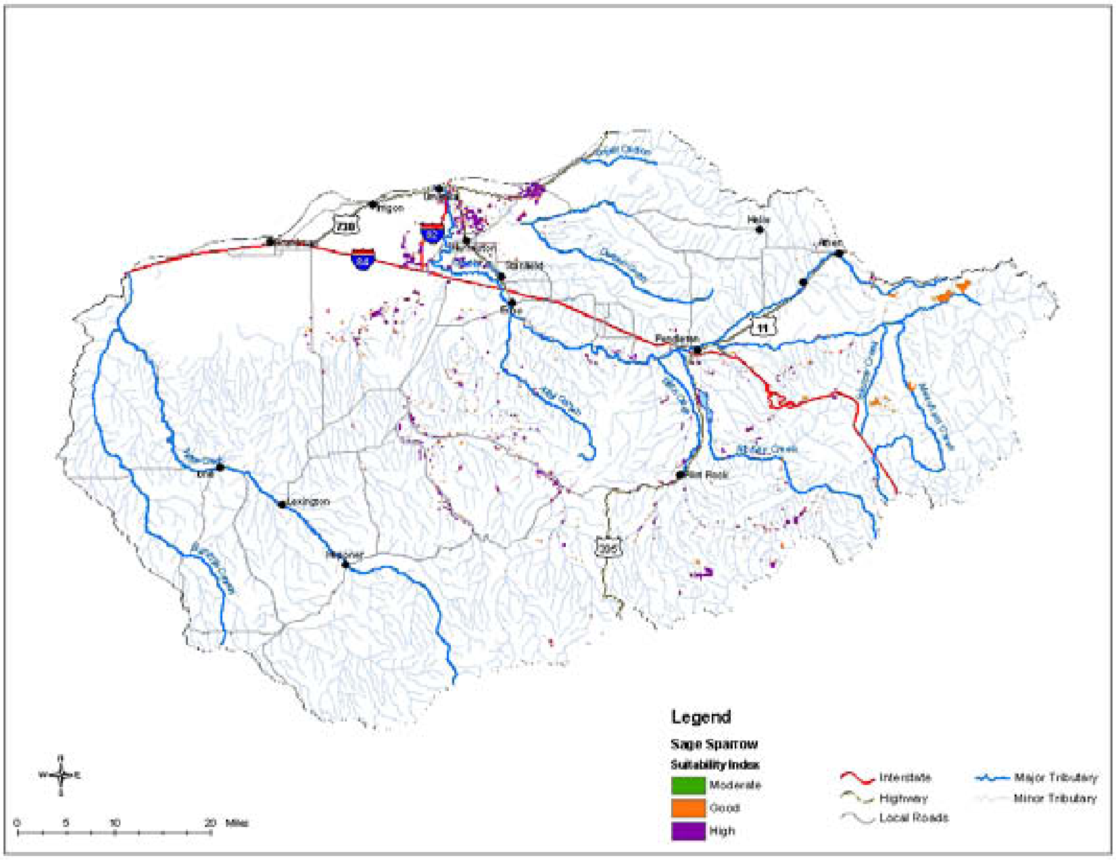

Figure 111. The distribution of potential habitat for the Sage Sparrow in the Umatilla/Willow subbasin as described by a suitability index.

Grasshopper Sparrow: Managers concluded that some of the same problems found in the suitability map for the Ferruginous Hawk also applies to the map of Grasshopper Sparrow habitat suitability (Figure 112). Specifically, no suitable habitat is shown in the western portion of the subbasin even though managers believe that suitable habitat exists in that area.

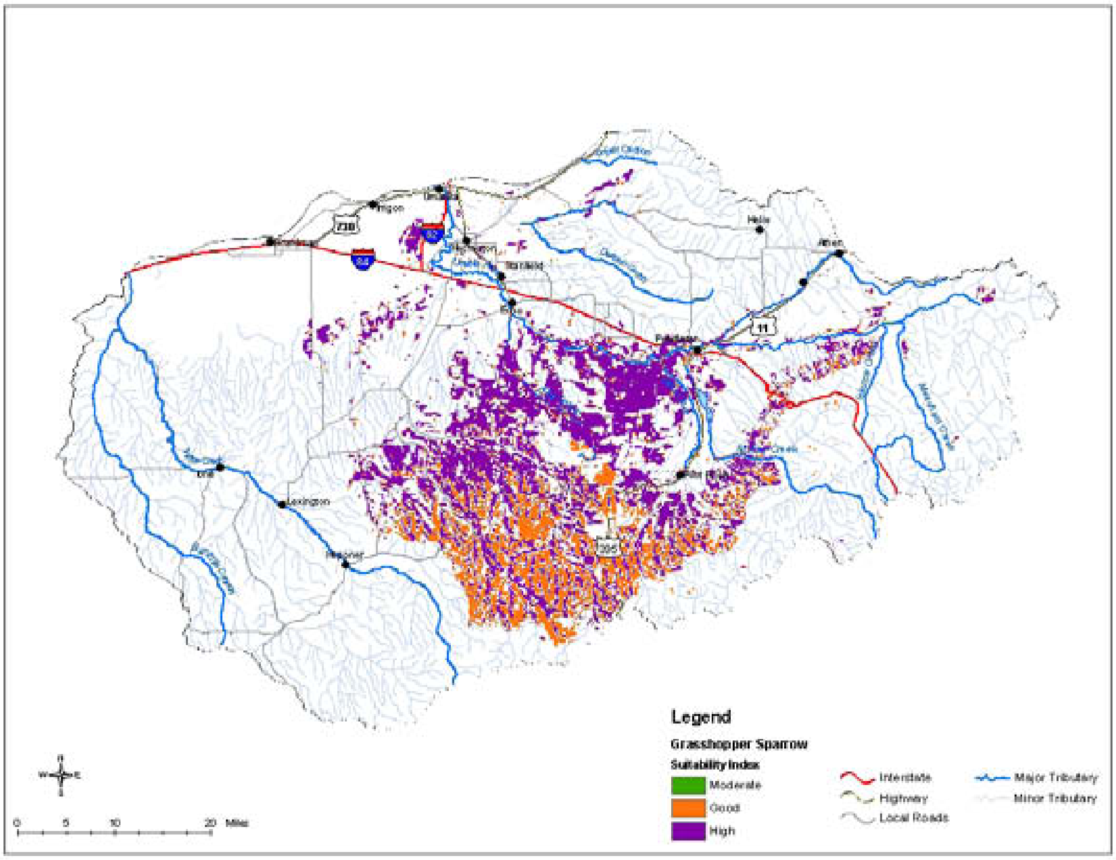

Figure 112. The distribution of potential habitat for the Grasshopper Sparrow in the Umatilla/Willow subbasin as described by a suitability index.

Conclusion: Although these preliminary maps vary in their accuracy, they illustrate excellent potential as a useful tool in directing management efforts. These initial attempts can be reworked or refined as further information is gathered on the ability of existing habitat to provide the key environmental correlates discussed below.

3.4.2.2 Key Environmental Correlates

Using the information provided in Appendix C, key environmental correlates, or environmental factors that influence the presence or viability of the focal species, were determined for each habitat. In some cases, environmental correlates of other obligate species were also included, using information presented by Altman and Holmes (2000a, b).

MIXED CONIFER FOREST

Focal Species: Pileated Woodpecker

High quality habitat for the Pileated Woodpecker and other species closely associated with mixed conifer is currently understood to be habitat with the following key environmental correlates:

- complex multi-layered closed canopies with a major component of large trees (>90 feet in height) and a high basal area
- mature seed producing trees
- numerous uneven-aged individual trees and an understory of smaller woody plants with emphasis on multi-conifer species composition including lodgepole pine, Douglas fir, Western larch, Engelmann spruce, subalpine fir, and white pine
- dead and dying trees 39 – 69 feet tall, 100-300 years old, and > 20 inches dbh
- dead and decaying wood, with an abundance of insects
- a minimum forest parcel size of 2,000 acres

PONDEROSA PINE FOREST

Focal Species: White-headed Woodpecker

High quality habitat for the White-headed Woodpecker and other species closely associated with ponderosa pine is currently understood to be habitat with the following key environmental correlates:

- large patches (> 800 acres) of open mature/old growth-dominated ponderosa pine
- canopy closures between 30-50%
- 2.5 snags per acre, with each snag > 24 inches dbh
- sparse understory vegetation

QUAKING ASPEN FOREST

Focal Species: Red-naped Sapsucker

High quality habitat for the Red-naped Sapucker and other species closely associated with quaking aspen incies is currently understood to be habitat with the following key environmental correlates:

- > 1.5 snags per acre
- trees > 39 feet in height and > 10 inch dbh
- patch size > 10 acres
- an abundance of trees with shelf fungus

Western Juniper Woodland

Focal Species: Ferruginous Hawk

High quality habitat for the Ferruginous Hawk and other species dependent on Western Juniper Woodland is currently understood to be habitat with the following key environmental correlates:

- isolated, mature juniper trees with a density > one per square mile
- native perennial grasses and other low shrub cover between 6-24 inches to support ground squirrels and jackrabbits, which are major prey of Ferruginous Hawks
- mature, short (< 33 ft. in height) juniper for Ferruginous Hawk nesting trees

Shrub-Steppe

Focal Species: Sage Sparrow

Characterizing very specific key environmental correlates that apply to all shrub-steppe habitat is difficult because shrub-steppe habitats are highly variable with respect to structure and plant species composition, both of which are strongly influenced by site conditions (e.g., hydrology, soil, topography). However, general ranges of critical environmental correlates that support the Sage Sparrow and most other obligate shrub species (e.g., Loggerhead Shrike, Burrowing Owl, Sage Thrasher) are as follows:

- late seral big sagebrush or bitterbrush with patches of tall shrubs with a height > 3 feet.
- mean sagebrush cover of 5-30%
- mean native herbaceous cover of 10-20% with <10% cover of non-native annual grass (e.g., cheatgrass) or forbs
- mean open ground cover, including bare ground and cryptogamic crusts > 20%
- mean native forb cover > 10%

Interior Grasslands

Focal Species: Grasshopper Sparrow

High quality habitat for the Grasshopper Sparrow and other grassland associated species is currently understood to be habitat with the following key environmental correlates:

<u>For Native Grasslands</u>

- native bunchgrass cover > 15% and comprising > 60% of total grassland cover

- tall bunchgrass (> 10 inches tall)
- native shrub cover < 10%

For Non-Native and Agricultural Grasslands (e.g. CRP lands)

- grass forb cover > 90%
- shrub cover < 10%
- variable grass heights (6-18 inches)

Landscape Level

- patch size > 100 acres or multiple small patches greater than 20 acres, within a mosaic of suitable grassland conditions
-

HERBACEOUS WETLANDS

Focal Species: Columbia spotted frog

High quality habitat for the Columbia spotted-frog and other obligate species is currently understood to be habitat with the following key environmental correlates:

- Abundant aquatic vegetation dominated by herbaceous species such as grasses, sedges, rushes. and emergent vegetation
- Clear, slow-moving or ponded perennial surface waters
- Relatively exposed, shallow-water (< 24 inches)
- Deep silt or muck substrate
- Small mammal burrows
- Undercut banks and spring heads

RIPARIAN WETLANDS

Focal Species: Great Blue Heron, Yellow Warbler, and American beaver

High quality habitat for these species is currently understood to be habitat with the following key environmental correlates:

- 40-60% tree canopy closure of cottonwood or other hardwood species
- multi-structure/age tree canopy (including trees 6 inches dbh and mature/decadent trees)
- woody tree groves > 1 acre and within 800 feet of water, where applicable
- vegetation within 328 feet of shoreline
- 40-80% native shrub cover, with more than 50% of shrub species being hydrophilic
- multi-structured shrub canopy > 3 ft tall

3.4.2.3 Functional Redundancy

In most cases, a number of species in a habitat have the same key ecological function, resulting in a habitat displaying a degree of functional redundancy. In general, as habitats are degraded and biodiversity is lost, the amount of functional redundancy is expected to decline. This section describes changes in functional diversity:

1) for species that create feeding, roosting, denning, or nesting opportunities (Figure 113)
2) for fungivores (Figure 114)
3) for grazers (Figure 115)
4) for species that affect soil structure and aeration (Figure 116)
5) for species that create structures (Figure 117)
6) for species that excavate trees and live in snags (Figure 118)
7) for total functional diversity (Figure 119)

Although changes in functional diversity vary according to ecological function, a general pattern exists for all ecological functions – a loss of functional redundancy in the eastern portion of the subbasin (indicated by the red area) in areas that were historically grasslands and that now are primarily agricultural lands.

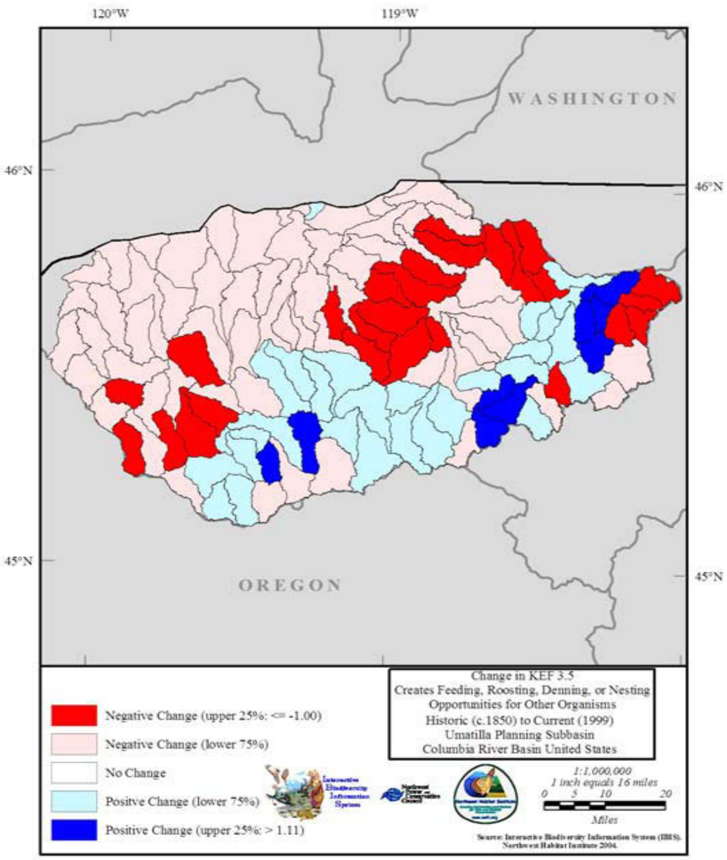

Figure113. Changes in key ecological function associated with species that create feeding, roosting, denning, or nesting opportunities for other species in the Umatilla/ Willow subbasin from c. 1850 to present.

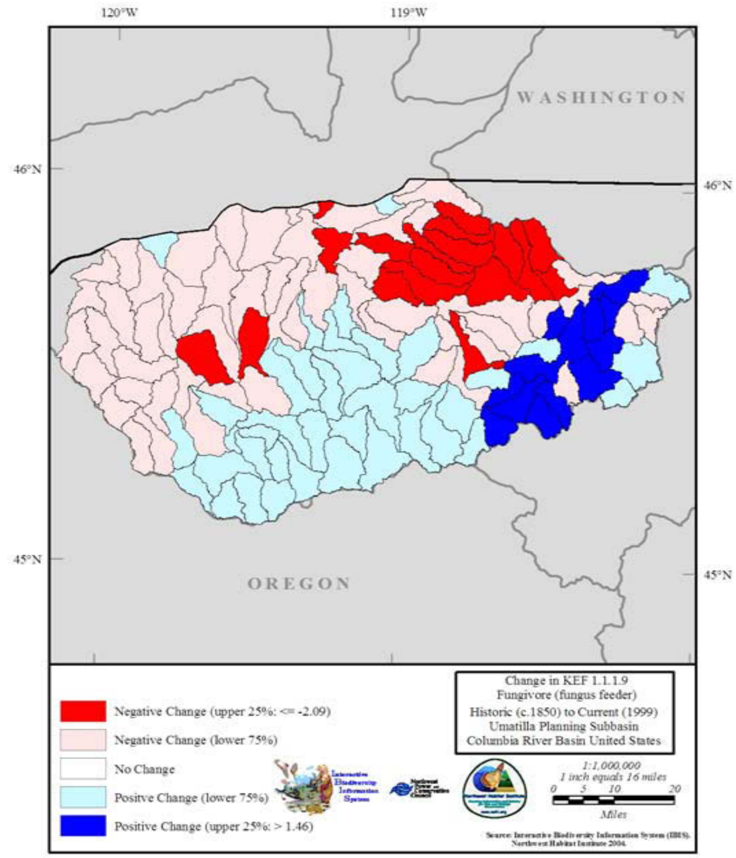

Figure 114. Changes in key ecological function associated with fungivores in the Umatilla/Willow subbasin from c. 1850 to present.

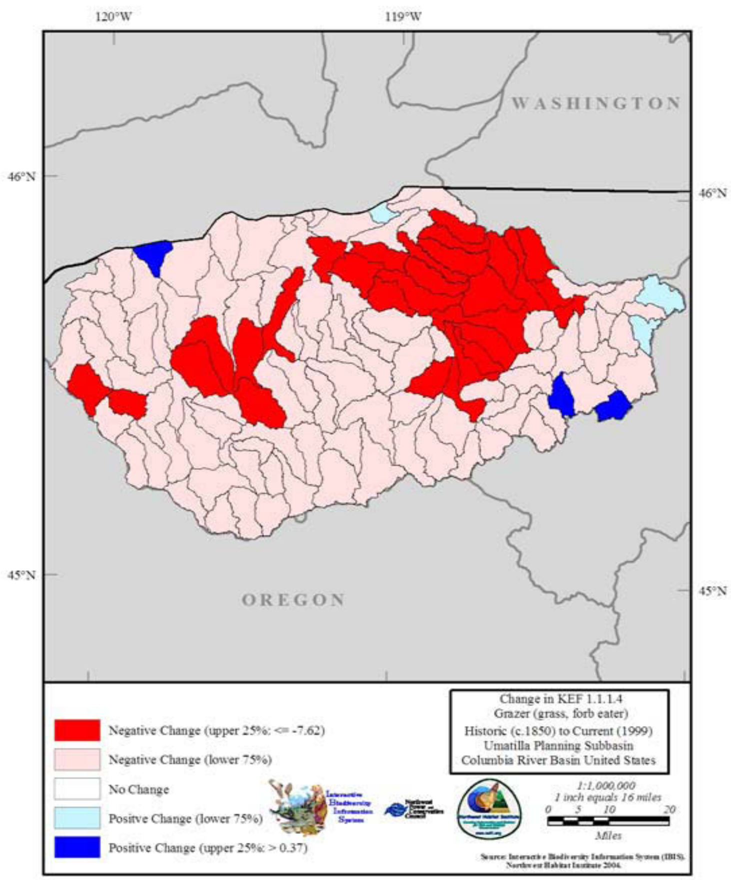

Figure 115. Changes in key ecological function associated with grazers in the Umatilla/ Willow subbasin from c. 1850 to present.

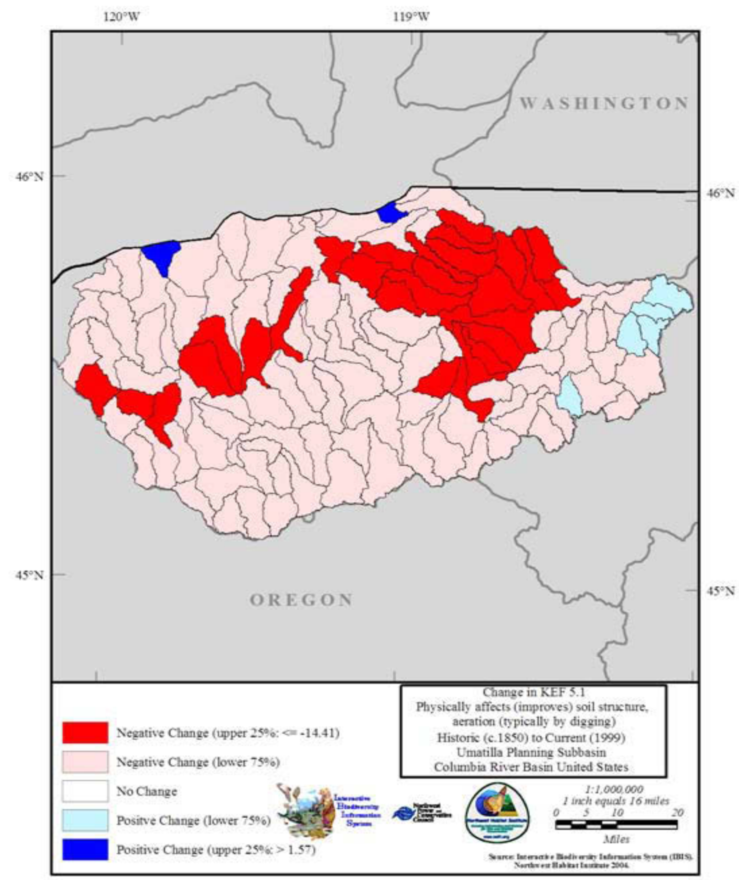

Figure 116. Changes in key ecological function associated with species that affect soil structure and aeration in the Umatilla/Willow subbasin from c. 1850 to present.

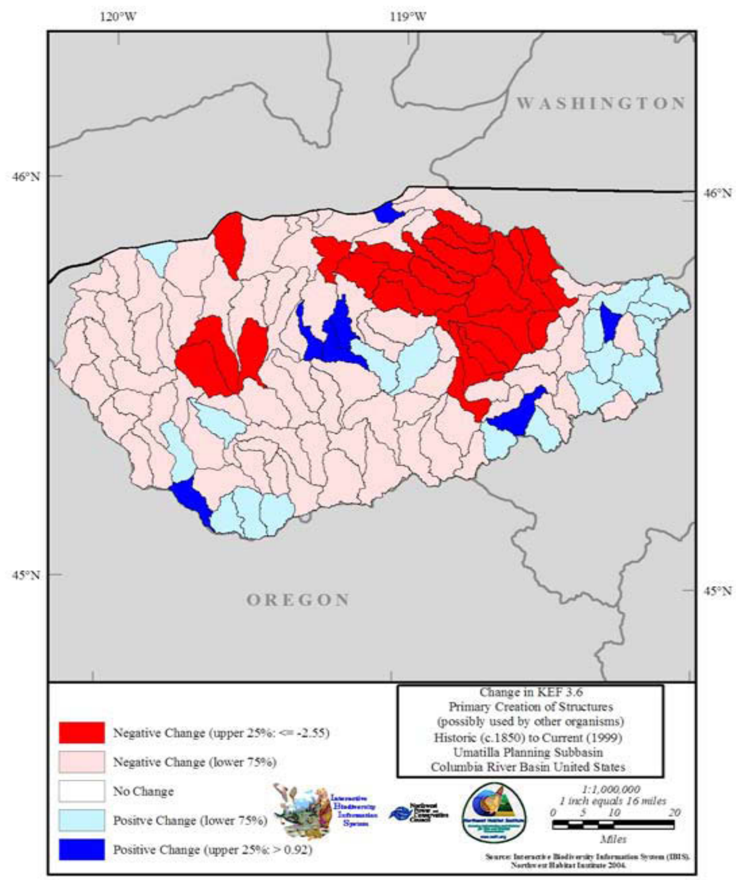

Figure 117. Changes in key ecological function associated with species that create structures in the Umatilla/Willow subbasin from c. 1850 to present.

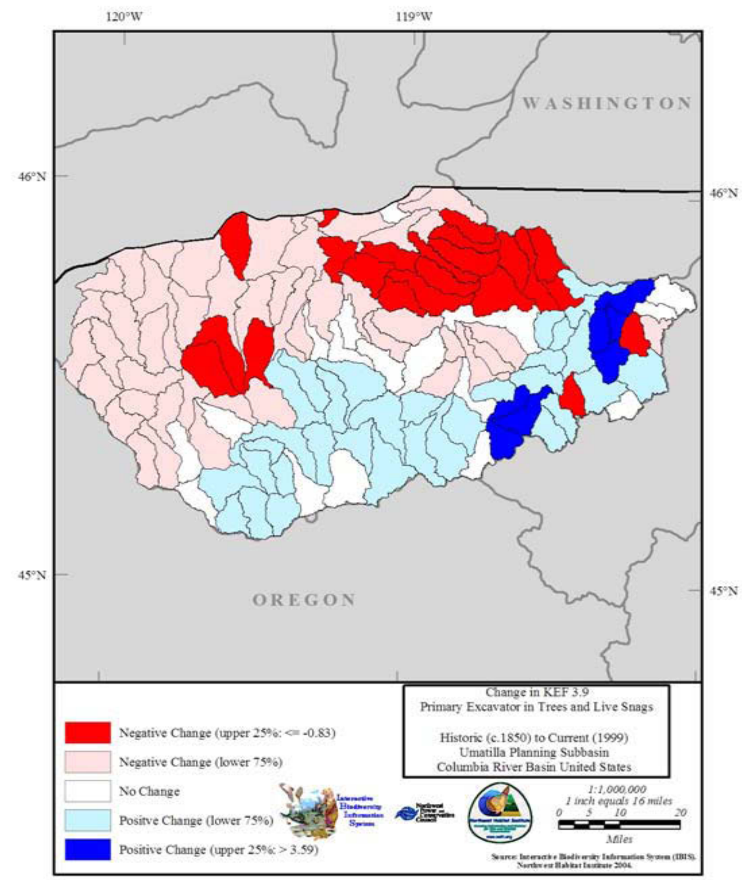

Figure 118. Changes in key ecological function associated with species that excavate trees and lives in snags in the c. 1850 to present.

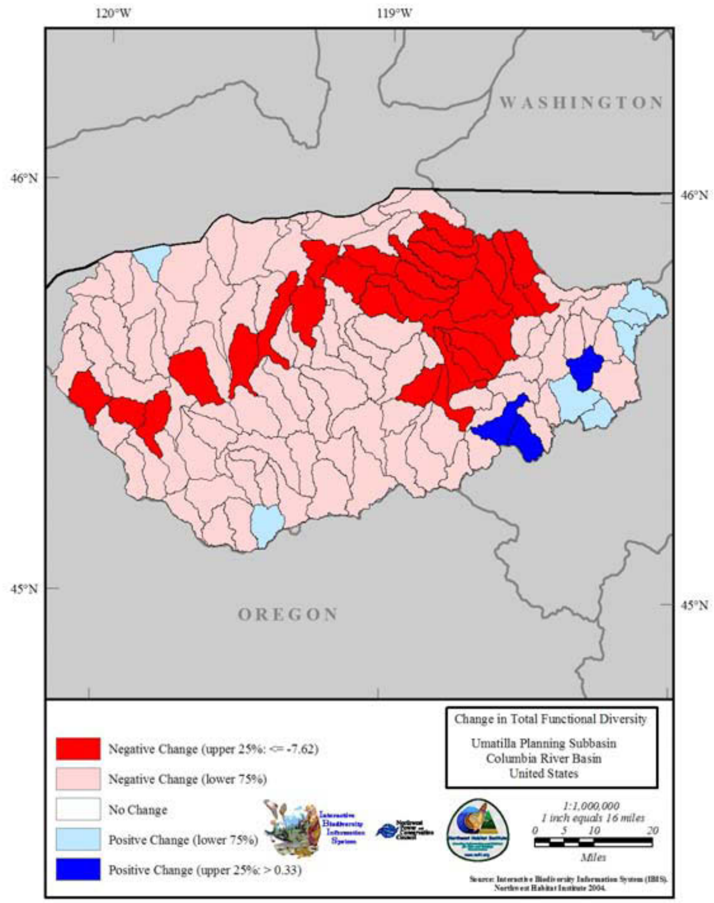

Figure 119. Changes in total functional diversity in the Umatilla/ Willow subbasin from c. 1850 to present.

3.4.3 Inter-species Interactions

3.4.3.1 Fish Inter-species Interactions

To date, no work has been conducted in the Umatilla/Willow subbasin that directly addresses interspecific interactions among fish, and this is a significant data gap for the subbasin. However, anecdotal evidence suggests that competition among fish species might be important in the growth rates of salmonids. In 1974 the Umatilla River was treated with rotenone to reduce the density of "trash" fish. ODFW personnel noted that fingerling rainbow trout stocked in the river for several years after the treatment grew rapidly. However, once other fish species came back into the river, the growth rates of juvenile trout were not as rapid and it is suspected that interspecific competition from several species of dace and shiners as well as squawfish, peamouth, and carp might have caused this reduction in trout growth rate (personal communication: J. Phelps, retired ODFW, April 2004).

Work in other subbasins provides additional information on species interactions that might occur in the Umatilla/Willow subbasin. These interactions include competition among salmonid species that can reduce reproductive success (Essington et al. 2000) and growth of individuals (Harvey and Nakamoto 1996). Competitive impacts might be particular severe on naturally produced salmonids when they compete with hatchery reared juveniles. McMichael et al. (2000) outline conditions for the Yakima subbasin in which hatchery reared steelhead had particularly harsh competitive impacts on naturally produced rainbow trout and spring Chinook. These impacts were particularly severe when:

- hatchery fish did not emigrate quickly
- water temperatures were above 8°C
- hatchery fish were the same species as wild fish
- habitat and/or food were limiting
- the number of hatchery fish releases was over 30,000

Predatory interactions might also be important. Steelhead are known to eat Chinook salmon eggs; however, the extent of this predation and its impact on Chinook is unclear (Vander Haegen et al. 1998). Squawfish are important predators of outmigrating smolts in the John Day reservoir (Rieman et al. 1991; Vigg et al. 1991) and these fish are considered common in the Umatilla River and some of its tributaries. Thus, it is possible that these fish are important predators on salmon and steelhead juveniles in the subbasin. Another potentially important predator-prey interaction in the subbasin involves bull trout. Large bull trout juveniles and adults are piscivorous, and include juvenile salmon in their diets (references in Buchanan et al. 1997). The distributions of reintroduced spring Chinook and bull trout overlap (see Figures 34 and 59 in Section 3.2.3.1) and juvenile spring Chinook are potentially a new and important food resource for the resident bull trout populations (personal communication: J. Phelps, ODFW retired, April 2004). However, whether reintroduced spring Chinook are important components of bull trout diets in the subbasin and what effect this might have on bull trout productivity is unknown at this time.

3.4.3.2 Wildlife Inter-species Relationships

A variety of interspecies relationships occur among the wildlife found within the subbasin. Many of the most important relationships are either trophic (i.e., predator-prey) or competitive in nature, which can impact the productivity and diversity of the wildlife community. Predation is an important interaction and in the subbasin. Birds of prey, including the American Kestrel, Osprey, and Golden Eagle, consume large numbers of small non-game wildlife such as rodents, and these predators potentially control the populations of their prey; however, this has not been examined in the subbasin. Predatory mammals might also be important in controlling their prey populations. Rodents, jack rabbits, and cottontails are all prey for red fox, black bear, bobcat, and lynx. Bobcat, lynx, and black bear also prey on both mule and white-tailed deer. However, these relationships have not received much attention in the subbasin.

Competition is also an important factor that can potentially impact wildlife communities. Species that compete most strongly are those that use similar resources and are essentially functionally redundant (see Section 3.4.2.3). As with predation, competitive interactions among wildlife species have received little attention in the subbasin and therefore it is not clear how important these interactions are in driving the population and community dynamics of wildlife.

3.4.3.3 Fish-Wildlife Interactions

A variety of interactions occur between fish and terrestrial wildlife. Perhaps three of the most important are: 1) fish as a food resource for terrestrial wildlife, 2) wildlife as "engineers" of salmonid habitat, and 3) the impact of marine-derived nutrients from anadromous fish on terrestrial wildlife habitat. These interactions are outlined below; however, very little work has been conducted on them in the Umatilla/Willow subbasin.

Many wildlife species consume salmon and steelhead. Table 25 in section 3.2.1.3 provides a list of 75 wildlife species that occur in the Umatilla/Willow subbasin that are known to consume salmon or steelhead eggs, fry, fingerlings, parr, smolts, adults, or carcasses (IBIS 2004). The recent hatchery supplementation of steelhead and the reintroduction of coho and fall and spring Chinook salmon into the subbasin has greatly increased the availability and abundance of all life history stages of salmon and steelhead as a food resources for these wildlife species. At this time, no studies have been conducted to specifically address changes in distribution, abundance or productivity of any of these species of wildlife with the recent increases in salmon and steelhead. However, ODFW biologists have noted a dramatic increase in the number of black bears gathering at the North Fork of the Umatilla River during spring Chinook spawning over the past five years (personal communication: T. Bailey, ODFW, April 2004), which suggests that the reintroduction of spring Chinook has had an impact on the behavior, distribution and possibly productivity of the black bear population in the subbasin.

Wildlife can also have important positive impacts on salmonids through their direct impact on stream habitat. The best example of this interaction is the creation of complex dynamic stream habitat by beaver (Naiman et al. 1988). Pools created by beaver dams might be particularly important habitat for juvenile salmon and steelhead. For example, in two coastal Oregon streams beaver ponds were important habitat for coho juveniles during summer low flows (Leidholt-Bruner et al. 1992). Beaver ponds were also found to be important overwintering habitat for bull trout and cutthroat trout in headwater streams in Montana (Jakober et al. 1998) and for juvenile coho salmon in Washington (Peterson 1982). Beaver abundances have most likely declined in the Umatilla/Willow subbasin since the time of the first fur trappers coming to the Blue Mountains in 1811 and driving beaver nearly extinct throughout the Northwest by 1840 (Langston 1995). It is unclear what impact this early removal of beaver had on salmon and steelhead populations in the subbasin.

Another important, but somewhat indirect, interaction between salmon and wildlife is the effect that salmon carcasses have on terrestrial wildlife habitat through the input of marine-derived nutrients. Salmon carcasses often end up in riparian areas either because they are washed up during high flows or because scavengers remove the carcasses from streams and do not consume the entire carcass (Cederholm et al. 1989). Decomposition of these carcasses and waste products from animals that consume these carcasses release nutrients that are then available to plants (Naiman et al. 2002). Work with stable isotopes reveals that marine-derived nitrogen makes up a substantial percentage (up to 26%) of the total nitrogen found in many riparian plants (Bilby et al. 1996; Naiman et al. 2002). This availability of marine-derived nutrients can greatly influence the rate of growth and size of vegetation in riparian zones. For example, Sitka spruce adjacent to streams with spawning salmon grow to a diameter of 50 cm in 86 years. This size is a big enough to create large woody debris that makes an important contribution to salmon habitat in the stream. However, in nearby streams in which salmon passage is blocked, it requires 307 years for Sitka spruce to achieve 50 cm in diameter (Naiman et al. 2002). In addition, marine-derived nutrients appear to have an important impact on the composition of riparian vegetation communities, with communities dominated by relatively large trees and having a species-poor understory characteristic of riparian areas adjacent to streams with salmon and a greater dominance and diversity of shrubs and understory vegetation in streams that lack salmon (Naiman et al. 2002). What impact this change in riparian vegetation growth rates and composition has on wildlife communities is unclear at this time; however, the impact on riparian vegetation suggests that this impact should be important.

3.5 Identification and Analysis of Limiting Factors/Conditions and Priority Areas for Action

3.5.1 Aquatic

3.5.1.1 EDT and QHA Modeling

Modeling approaches were used to provide quantitative measures of the impact of environmental factors on the abundance and productivity of the focal species in the subbasin. For salmon and steelhead the Ecosystem Diagnostic and Treatment Tool (EDT) was used to identify limiting factors, to prioritize geographic areas, and to examine the impact of restoration scenarios on steelhead and salmon abundance and productivity. Very briefly, EDT requires the division of a subbasin's streams into reaches (areas that are physically similar). Up to 46 environmental attributes are used to characterize each reach and these attributes take two values, a value based on current measurements/estimates and a value based on historic estimates. Based on these environmental attributes, the model compares estimates of historical abundance and productivity to current estimates and then defines which environmental factors are currently limiting populations and in which areas.

The Umatilla River subbasin was divided into 310 reaches. To make results easier to interpret, reaches are lumped into geographic areas (GAs). For the Umatilla River subbasin the 310 reaches were lumped in 46 GAs (Figure 123). EDT ranks GAs by restoration potential – which GAs will produce the greatest increase in productivity and abundance with restoration – and by protection value – which GAs are most important to maintain at their current state. Thus, EDT ranks the areas within a subbasin that are most important to restore and to protect (e.g., through conservation easements). EDT can also be used to examine the impact on focal species of different restoration scenarios, and thus provides an important tool to estimate the benefits of restoration and protection. Finally, EDT is also used to examine Properly Functioning Conditions (PFCs) and their impact on steelhead and salmon populations. PFCs represent the "best" possible state of the environment given the local economic, social, and political constraints and they can serve as a long-term goal (see Section 3.6.1). More information regarding EDT can be found at www.edthome.org.

Methodologies have not been developed for using EDT with non-anadromous species. Therefore, a simpler model, Qualitative Habitat Analysis (QHA), was used to determine limiting factors and priority reaches for bull trout. In addition, QHA was used to assess limiting factors and priority reaches for redband trout in Willow Creek. QHA is primarily for use on resident salmonids in stream habitats on a watershed scale. QHA requires the user to rate 11 attributes (riparian condition, channel stability, habitat diversity, fine sediment, high and low flow, oxygen, high and low temperature, pollutants, and obstructions) in both the current and reference (i.e., historic) conditions in each stream reach being rated. The user must then develop a hypothesis relating the importance of these attributes to a focal species on a reach-by-reach basis for each of four life stages (spawning/incubation, summer rearing, winter rearing, migration). QHA produces a series of tables that describe the physical habitat and identify where restoration and/or protection activities may be the most productive.

Use of professional judgment (or expert opinion -- for our purposes the two concepts are synonymous) is often criticized for being subjective and lacking consistency. On the other hand, it is well recognized that a strictly quantitative approach may not always be possible, or even preferred. For example, using a quantitative approach may not make sense in areas where data are limited, when there is not enough time allotted to conduct a rigorous quantitative assessment, or where appropriate tools or expertise are not available. In these situations a more qualitative approach is indicated. The 2000 *Template for Subbasin Assessment*, for example, referenced the use of “opinions of local fish managers” as an analytical tool.

The QHA was designed to minimize problems associated with unstructured qualitative assessments. QHA is a “structured qualitative assessment.” In other words, it is a systematic and objective assessment of species habitat relationships that relies principally on existing local professional knowledge and judgment but that “structures” the process by: (1) following a logical and replicable sequence, (2) using the best available quantitative data as the basis for decisions, (3) generating a product that is similar in form to products resulting from other more quantifiable approaches, and (4) documenting the decision process.

QHA relies on the same conceptual framework as the more technically sophisticated Ecosystem Diagnosis and Treatment (EDT) technique. There are, however, several significant differences. While each of the habitat characteristics used in QHA is also used in EDT, EDT considers many more habitat factors and seeks to link these directly to measurable data. QHA, by contrast, relies on the judgment of knowledgeable professionals to draw this link.

EDT relies on a set of biological rules derived from the technical literature to establish the link between a species and its habitat. Again, QHA relies on professional judgment to make this link. EDT uses a series of life history trajectories to model the movement of fish through its environment over several life stages. QHA collapse life history into fewer stages and treats each stream reach or small watershed as a static unit. Again, QHA relies on the knowledge of experts to think through these life history dynamics.

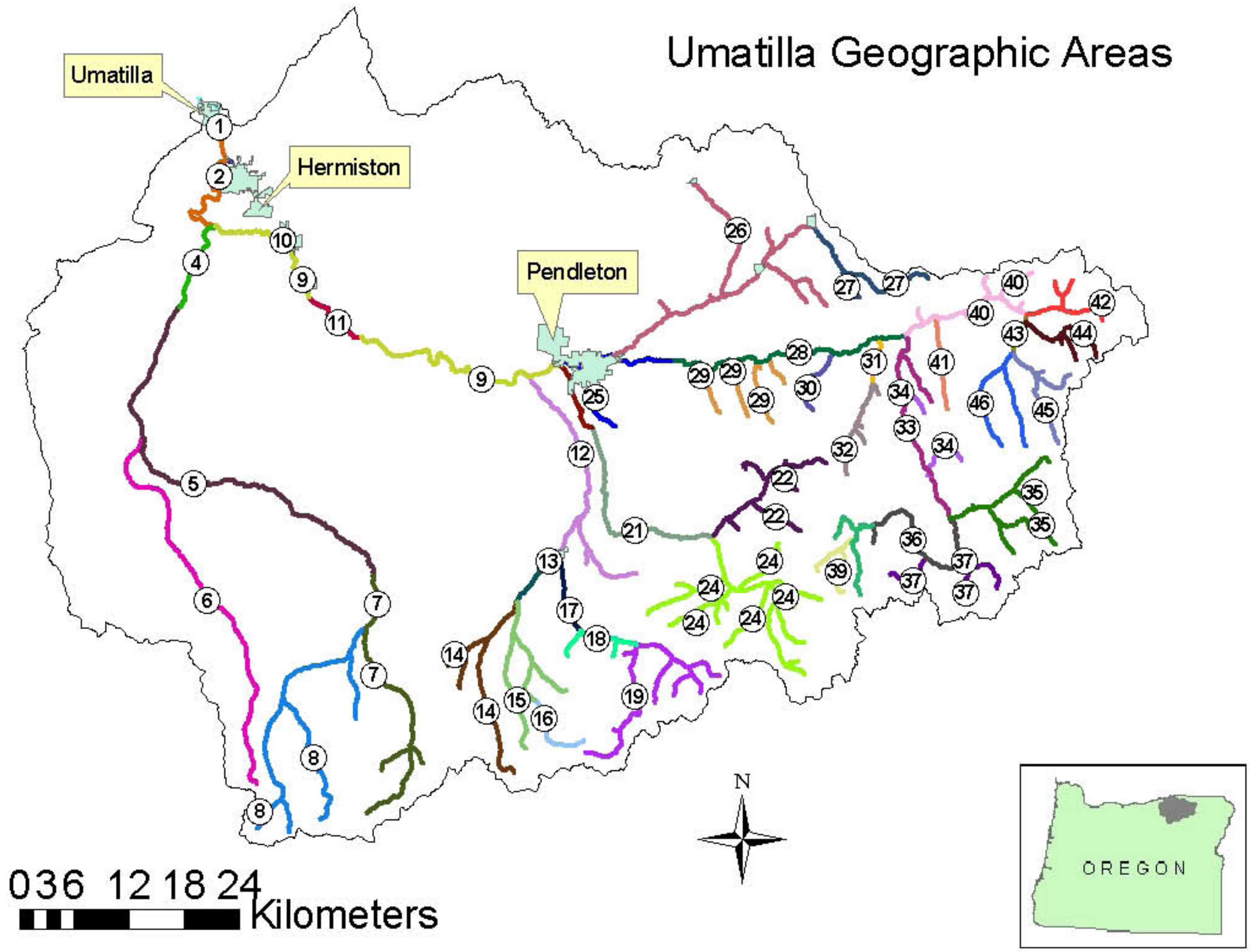

Figure 123. Geographic areas used in the EDT analysis for the Umatilla River subbasin.

EDT analysis can incorporate, or, more accurately, link to information on out-of-subbasin effects, i.e., survival outside of the natal subbasin. QHA relies on expert opinion to make this connection.

Lastly, EDT produces a series of numerical products that estimate productivity, abundance, and related factors that give an indication of how well habitat supports fish. As a qualitative technique QHA does not generate these outputs but rather produces a series of products that suggest directions for management but explicitly leaves the decision process up to experts.

More information on the QHA model can be found at www.nwcouncil.org/fw/subbasinplanning/admin/guides/qha.pdf.

3.5.1.2 Limitations of the Current Analysis

Passage Barriers
There exists a lack of knowledge regarding passage barriers in the Umatilla/Willow subbasin both in terms of severity of potential known barriers and numbers of barriers (particularly in non-anadromous sections of the Umatilla River subbasin and throughout the Willow Creek subbasin). This lack of knowledge represents a limitation to both the EDT and QHA approaches and the consensus of the aquatic working group is that the severity of these passage problems has been underestimated by both models. In the Umatilla River subbasin, 36 barriers have been identified and these are listed, along with their priority for removal, in Table 1.

General Limitations of EDT
A number of problems associated with the EDT model were identified during the planning process. EDT is a useful tool that should serve well as the Columbia Basin habitat modeling standard. In general the model simulates habitat attributes and habitat change with sufficient precision and resolution to effectively plan restoration activities. However, the model has at least one significant habitat limitation, and at least one significant fish limitation.

EDT represents temperature and flow using two variables: a categorical description of the temperature and flow situation, and a monthly shaping and focus of the environmental regime. The shapings used in the model are counter intuitive and clumsy, and prevent the utilization of real data. Many subbasins have hydrograph and thermographs of their primary tributaries, and the Umatilla is no exception. Future versions of the model should be built to directly incorporate thermograph and hydrograph information.

EDT represents fish survival using an expanded Beverton-Holt model. Although EDT represents a leap forward by explicit representing fish-habitat relationships, it represents a leap backwards in terms of modeling fish populations. Decades of fishery management have made clear that although associative aggregated differential models of populations

Table 45. Barriers to upstream passage on streams in the Umatilla River subbasin.

Stream	River Mile	Barrier Type	Step Height Est. (m)	Degree	Recommended Action	Priority
Umatilla R.	1.5	Channel Mod.	0.7	Partial	Modify	L
Umatilla R.	2.0	Irrigation Dam	1.2	Partial	Modify	H
Umatilla R.	10.1	Hydro Dam	1.5	Partial	Modify/Remove	M
Umatilla R.	23.7	Irrigation Dam	1.5	Partial	Modify	M
Umatilla R.	27.5	Irrigation Dam	1.5	Partial	Modify	L
Umatilla R.	28.5	Irrigation Dam	2	Partial	Modify	H
Umatilla R.	49	Irrigation Dam	1.2	Partial	Remove	M
Butter Creek	7.9	Flash Boards	2.3	Complete	Modify	L
Butter Creek	27.2	Irrigation Dam	1.4	Complete	Modify	L
Butter Creek	43.0	Irrigation Dam	1.2	Complete	Modify	L
Johnson Cr. (Butter Trib)	0.3	Culvert	0.8	Partial	Modify	M
Birch Creek	0.5	Pipe Casing	1.4	Partial	Modify	M
Birch Creek	2.5	Irrigation Dam	1.5	Partial	Modify/Remove	H
Birch Creek	5.0	Irrigation Dam	1.2	Partial	Modify/Remove	H
Birch Creek	10.0	Irrigation Dam	1.0	Partial	Remove	M
Birch Creek	11.0	Irrigation Dam	0.7	Partial	Remove	L
Birch Creek	12.0	Irrigation Dam	1.0	Partial	Modify	M
Birch Creek	15.0	Irrigation Dam	1.7	Partial	Remove	H
West Birch Cr.	1.0	Irrigation Dam	?	Partial	Modify	M
West Birch Cr.	3.5	Irrigation Dam	2.1	Partial	Modify	H
West Birch Cr.	3.8	Bridge	1.2	Partial	Modify	H
West Birch Cr.	5.5	Irrigation Dam	1.4	Partial	Remove	H
West Birch Cr.	8.5	Irrigation Dam	1.5	Partial	Remove	H
Bridge Cr. (W Birch)	2.0	Culvert	?	Complete	Modify	H
East Birch Cr.	4.0	Irrigation Dam	0.7	Partial	Remove	L
East Birch Cr.	9.0	Irrigation Dam	1.0	Partial	Remove	L
Jungle/Windy Spr. (Pearson)	0.1	Culvert	0.15	Partial	Modify	L
Wildhorse Cr.	0.1	Irrigation Dam	0.7	Partial	Modify	L
Wildhorse Cr.	18.8	Bridge	1.0	Partial	Modify	L
Greasewood Cr.	0.4	Irrigation Dam	0.6	Partial	Modify	L
Mission Cr.	0.9	Bedrock Drop	0.5	Partial	Modify	M
Mission Cr.	3.3	Bridge/Culvert	0.7	Partial	Modify	M
Coonskin Cr.	0.3	Bridge	0.5	Partial	Modify	M
Coonskin Cr.	0.9	Pipe Casing	1.1	Partial	Modify	M
Whitman Spr.	0.1	Culvert	0.5	Complete	Modify	L
Red Elk Can.	0.2	Culvert	0.8	Partial	Modify	L
Minthorn Spr.	0.1	Culvert	0.5	Partial	Modify	L
Unnamed Trib to SF Umt. RM 1.5	0.1	Culvert	0.5	Complete	Modify	M
Camp Creek	0.25	Irrigation Dam	1.3	Partial	Remove	M
Unnamed trib to Umt R. RM 81.2	0.1	Culvert	0.6	Partial	Modify	L
Twomile Creek	1.25	Culvert	?	?	Modify	L

can represent density-dependent mortality relatively well at gross scales, mechanistic models of individuals are far more explanatory. The power of mechanistic models has been demonstrated in the life's work of D. Boisclair, S.A.L.M. Kooijman, E.E. Werner, J. Kitchell, and S. Carpenter, and is strongly related to their ability to represent physiological processes and the impacts of sub-lethal permutations on production and productivity. Future versions of EDT should be developed using individual based calculations of growth and production, and should have the capacity to represent metabolic processes including bioaccumulation and resource dependent growth.

Problems with the draft Umatilla EDT Model

The modelers attempted to fix problems with the Umatilla EDT model as they were discovered throughout the planning process. The draft Umatilla EDT model represents a best first effort to develop a functional representation of the Umatilla Subbasin, and is a work in progress. Two problems were discovered late in the planning process; too late to be rectified before the Subbasin Plan deadline. First, a routing error runs all migrating adults and juveniles through EDT reach #7 "NH Drain"; a small tributary in the lower Umatilla. The impacts of this routing error are unknown. Second, EDT temperature and flow curves were developed for the Umatilla many months ago. Since that time the methods for describing temperature and flow were finalized and codified. The routing, temperature, and flow curves for the Umatilla model should be updated prior to a finalization of the Umatilla Subbasin Plan. Although these changes may impact the absolute abundance estimates of the EDT model, it is not expected that they will impact the magnitude of change expected from restoration actions described in the management plan. In addition, as stated above, the impact of passage barriers have most likely been underestimated in the current analysis, for both EDT and QHA; much survey work is needed to map all potential passage barriers and to understand the degree to which each one impacts fish passage.

Finally, a number of habitat attributes (especially the ecological attributes and several water quality parameters such as bedscour, pesticides, total suspended solids, and others) were derived using professional judgment or simply left blank in the Umatilla EDT model. This information can be collected in the field using standardized methods, and should be addressed within five years following this plan. This will ensure that future permutations of the Umatilla EDT model are based more on real conditions, and less on the conjecture of scientists. Most of these parameters are not represented in ongoing monitoring and evaluation activities, and additional support from BPA or other funding agencies will be required before they can be addressed.

3.5.1.3 Identification of Limiting Factors

EDT

The EDT modeling approach provides a quantitative measure of the impact of 46 environmental attributes (see Appendix E pages 1-22) on the abundance and productivity of the four anadromous focal species – steelhead, spring Chinook, fall Chinook, and coho. These attributes are then grouped into 16 “survival” or “limiting” factors:

- Flow
- Channel stability
- Habitat diversity
- Key habitat quantity
- Obstructions
- Withdrawals
- Sediment load
- Oxygen
- Chemicals
- Temperature
- Food
- Competition (with hatchery fish)
- Competition (with other species)
- Predation
- Pathogens
- Harassment/Poaching

In a qualitative sense, limiting factors are ranked as having high (or large), medium, low, or no impact on focal species survival. To determine which factors are most pervasive in the subbasin in limiting the survival of anadromous focal species, the percentage of geographic areas (GAs) in which a factor is limiting was determined for each species. Figures 124 through 127 show the limiting factors that had a high impact on survival and the proportion of geographic areas (out of the total number that species is found in) in which they occurred.

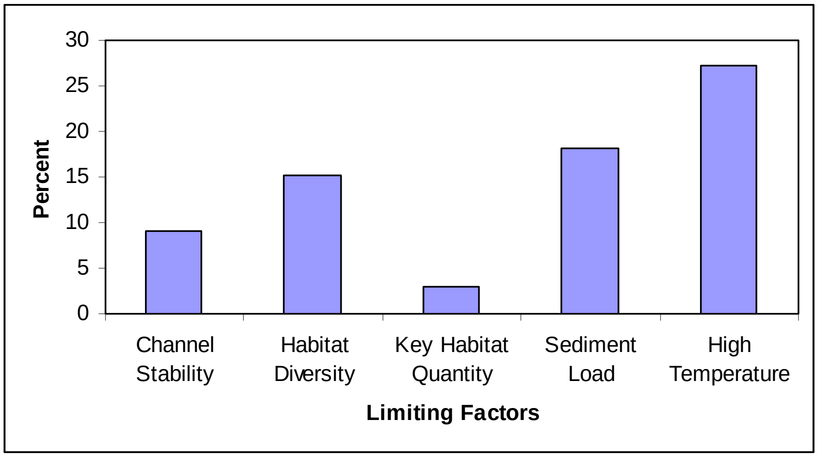

Figure 124. The percentage of all geographic areas in which the graphed limiting factors have a large impact on the survival of coho. Coho are found in a total of 32 GAs.

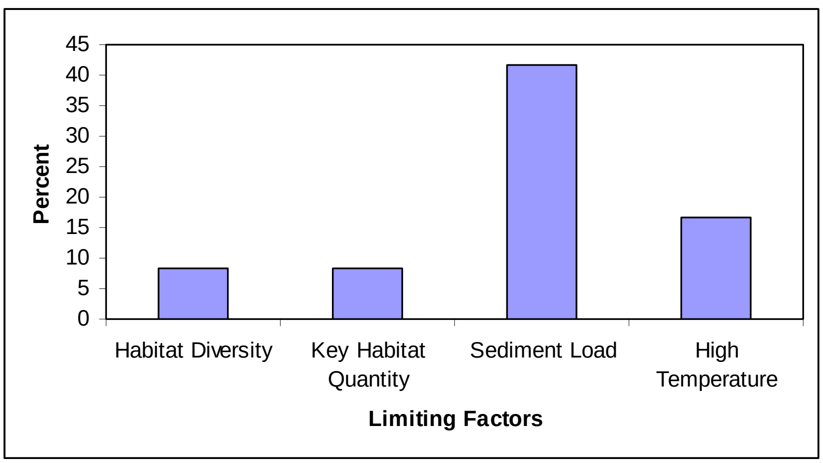

Figure 125. The percentage of all geographic areas in which the graphed limiting factors have a large impact on the survival of fall Chinook. Fall Chinook are found in a total of 12 GAs.

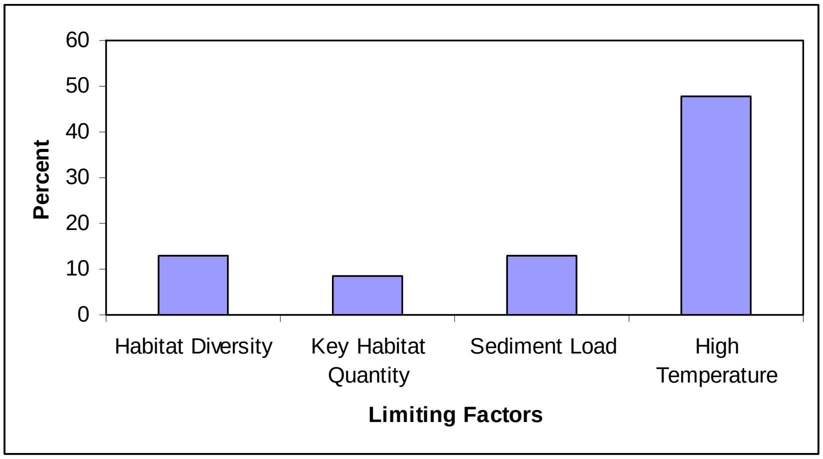

Figure 126. The percentage of all geographic areas in which the graphed limiting factors have a large impact on the survival of spring Chinook. Spring Chinook are found in a total of 22 GAs.

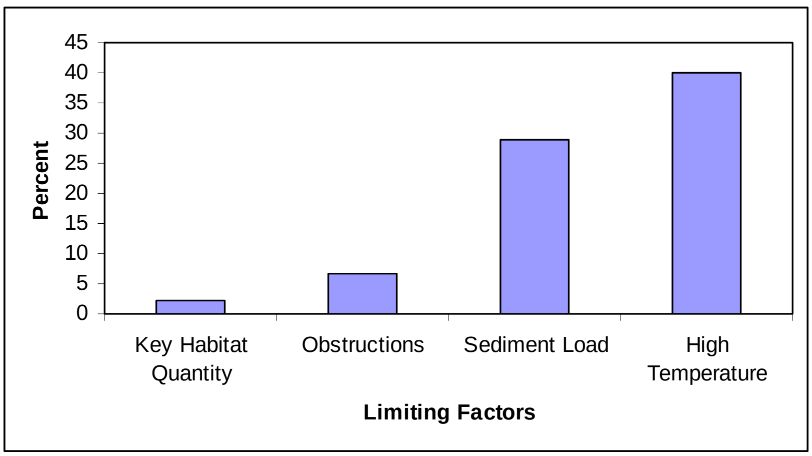

Figure 127. The percentage of all geographic areas in which the graphed limiting factors have a large impact on the survival of steelhead. Steelhead are found in a total of 44 GAs.

These figures reveal that the two most pervasive factors having a large impact on the survival of the four anadromous focal species are sediment load and high water temperature. High water temperature is the most pervasive factor that has a large impact on the survival of coho, spring Chinook, and steelhead; and sediment load is the second most pervasive factor for coho and steelhead. Sediment load was the most pervasive factor having a large impact on fall Chinook survival with high water temperature being second.

Figures 128 through 131 show the pervasiveness of limiting factors that had a medium impact on survival for each of the four species. As shown in these figures, habitat factors become important in terms of limiting the survival, at a medium level, of the anadromous focal species.

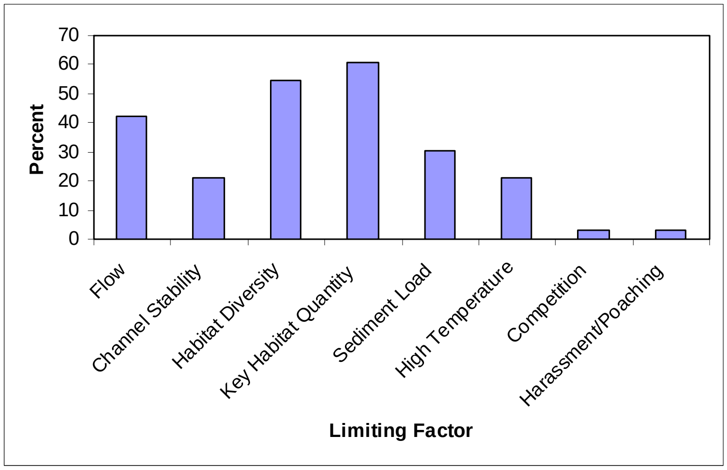

Figure 128. The percentage of all geographic areas in which the graphed limiting factors have a medium impact on the survival of coho. Coho are found in a total of 32 GAs.

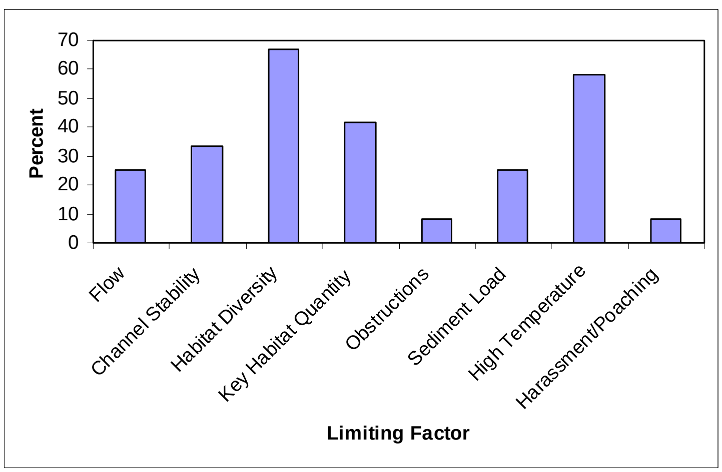

Figure 129. The percentage of all geographic areas in which the graphed limiting factors have a medium impact on the survival of fall Chinook. Fall Chinook are found in a total of 12 GAs.

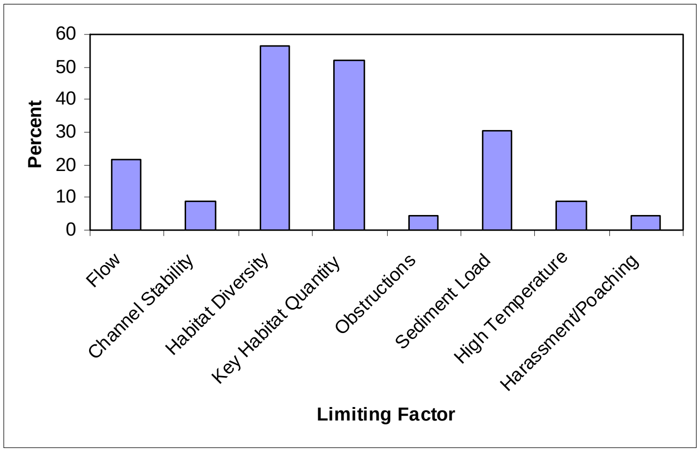

Figure 130. The percentage of all geographic areas in which the graphed limiting factors have a medium impact on the survival of spring Chinook. Spring Chinook are found in a total of 22 GAs.

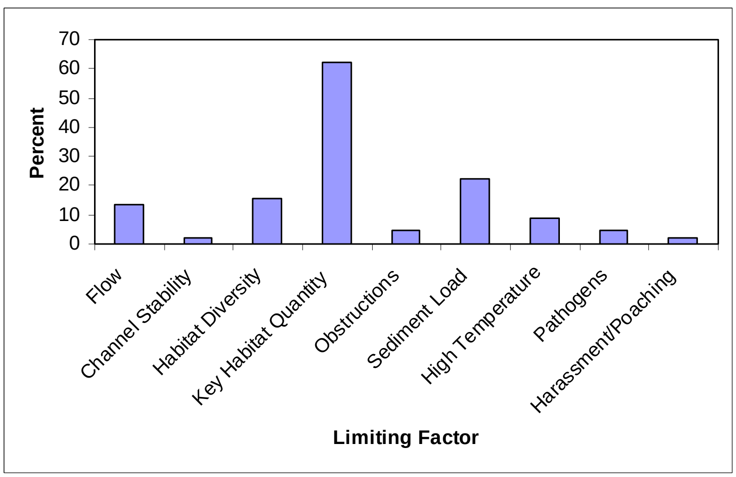

Figure 131. The percentage of all geographic areas in which the graphed limiting factors have a medium impact on the survival of steelhead. Steelhead are found in a total of 44 GAs.

The above graphs depicting limiting factors with a medium impact on survival reveal that both habitat diversity and habitat quantity are important limiting factors that are pervasive throughout the subbasin for all four anadromous focal species.

QHA
For QHA modeling, values for 11 environmental attributes are placed into the model and the model then determines which attributes are most important in each geographic area in terms of limiting the species of interest. Table 46 lists the 11 attributes and their definitions.

Table 46. Qualitative Habitat Analysis (QHA) attributes and definitions.

Attribute (abbreviation)	**Definition**
Riparian Condition (Rip Cond)	Condition of the stream-side vegetation, land form and subsurface water flow
Channel form (Ch form)	The condition of the channel in regard to bed scour and artificial confinement. Measures how the channel can move laterally and vertically and to form a "normal" sequence of stream unit types.
Channel complexity (Ch comp)	Diversity and complexity of the channel including amount of large woody debris (LWD) and multiple channels
Fine Sediment (F Sed)	Amount of fine sediment within the stream, especially in spawning riffles
High Flow (H Flow)	Frequency and amount of high flow events
Low Flow (L Flow)	Frequency and amount of low flow events
Oxygen (Oxygen)	Dissolved oxygen in water column and stream substrate
High Temperature (H Temp)	Duration and amount of high summer water temperatures that can be limiting to fish survival
Low Temperature (L Temp)	Duration and amount of low winter temperatures that can be limiting to fish survival
Pollutants (Poll)	Introduction of toxic (acute and chronic) substances into the stream
Obstructions (Obs)	Impediments to fish passage

The QHA for bull trout provided a ranking of stream reaches for both habitat protection and habitat restoration. Stream reaches are ranked high for protection where significant loss of production could occur if the habitat were degraded. Stream reaches ranked high for restoration are reaches where significant gains in fish production could be made by restoring habitat to historic conditions. However, it is not assumed nor necessarily intended that habitats will be restored to historic conditions. The QHA methodology simply provides a tool for prioritizing future efforts geographically to restore and protect fish habitat. Tables 47 and 48 show the approximately top 20 ranked restoration and protection reaches, respectively, for bull trout. In addition, QHA ranks the 11 habitat attributes in order of importance in limiting the population of interest. Table 47 shows the top 3 ranked attributes for each geographic area for bull trout. These are the attributes that, if improved, would provide the greatest restoration benefit. Generally, the Umatilla

River from Meacham Creek to the forks and Meacham Creek from the mouth to the North fork are the most important areas for restoration. These same areas plus the North Fork Umatilla and tributaries are the important areas for protection.

Table 47. Bull Trout Priority Reaches for Restoration

Reach	**Reach Description**	**QHA Rank**	**Limiting Factors**
Um 46	From Ryan Cr to StarveToDeath	1	Ch Comp, H Temp, Ch form
Um 47	From StarveToDeath to Hagar	1	Ch Comp, H Temp, Ch form
Um 48	From Hagar Cr to Bobsled Cr	1	Ch Comp, H Temp, Ch form
Um 49	From Bobsled Cr to fork in Bar M Road	1	Ch Comp, H Temp, Ch form
Um 50	From fork in Bar M Road to Rock Cr	1	Ch Comp, H Temp, Ch form
Um 51	From Rock Cr to Bear Cr	1	Ch Comp, H Temp, Ch form
Um 52	From Bear Cr to Lick Cr	7	Ch Comp, Ch Form, Rip Cond
Um 53	From Lick Cr to NF/SF	7	Ch Comp, Ch Form, Rip Cond
Meacham 5	From Duncan Canyon to NF	9	Ch Comp, Poll, Ch Form
Um 32	From McKay Cr to Tutuilla Cr	10	Rip Cond, Ch Comp, H Flow
Meacham 1	From mouth at Umatilla R to Boston Canyon	11	Ch Comp, Poll, H Flow
Meacham 2	From Boston Canyon to Line Cr	11	Ch Comp, Poll, H Flow
Meacham 3	From Line Cr to Camp Cr	11	Ch Comp, Poll, H Flow
Meacham 4	From Camp Cr to Duncan Canyon	11	Ch Comp, Poll, H Flow
Um 5	Threemile Dam	15	Obstr, H Flow, Ch Comp
Um 43	From Meacham Cr to Fred Gray's Bridge	16	Ch Comp, H Temp, H Flow
Um 44	From Fred Gray's Bridge to Hillbilly Cr	16	Ch Comp, H Temp, H Flow
Um 45	From Hillbilly Cr to Ryan Cr	16	Ch Comp, H Temp, H Flow

While the priority protection reaches shown in Table 4 were ranked by QHA, planners are not anticipated to actually set priorities for protection based on this ranking. Protection of each of these reaches is considered of equal priority, and actions to protect current habitat value should be taken whenever and wherever the opportunity exists. However, programs focused on implementing passive restoration projects should consider the QHA ranking with respect to project planning, and planners should target the highest ranked reaches first.

Table 48. Bull Trout Priority Reaches for Protection

Reach	Reach Description	QHA Rank
UM NF2	From Coyote Cr to Johnson/Woodward Cr	1
UM NF1	From confluence of Umatilla R SF to Coyote Cr	2
UM 52	From Bear Cr to Lick Cr	3
UM 53	From Lick Cr to NF/SF	3
UM 46	From Ryan Cr to StarveToDeath	5
UM 47	From StarveToDeath to Hagar	5
UM 48	From Hagar Cr to Bobsled Cr	5
UM 49	From Bobsled Cr to fork in Bar M Road	5
UM 50	From fork in Bar M Road to Rock Cr	5
UM 51	From Rock Cr to Bear Cr	5
Meacham NF 3	From Bear Cr to Pot Cr	11
UM NF 3	From Johnson/Woodward Cr to falls	12
Meacham NF 4	From Pot Cr to Falls at 3400 ft level	13
Pot Cr 1	From mouth at Meacham Cr to Canyon Cr	13
Meacham NF 2	From Sawmill Cr to Bear Cr	15
Meacham NF 1	From mouth at Meacham Cr to Sawmill Cr	16
Coyote 1	From mouth at Umatilla NF to WF/EF	17
UM 43	From Meacham Cr to Fred Gray's Bridge	18
UM 44	From Fred Gray's Bridge to Hillbilly Cr	18
UM 45	From Hillbilly Cr to Ryan Cr	18

The QHA for redband trout provided a ranking of stream reaches for both habitat protection and habitat restoration. Stream reaches are ranked high for protection where significant loss of production could occur if the habitat were degraded. Stream reaches ranked high for restoration are reaches where significant gains in fish production could be made by restoring habitat to historic conditions. However, it is not assumed nor necessarily intended that habitats will be restored to historic conditions. The QHA methodology simply provides a tool for prioritizing future efforts geographically to restore and protect fish habitat. The amount of restoration that actually occurs will be based primarily on the willingness of private landowners to work cooperatively with resource managers to improve habitat as most of the Willow Creek watershed is under private ownership.

Priority reaches for restoration of redband trout habitat in Willow creek ranked from 1 to 19 are shown in Table 49 (more than 19 reaches are listed because some were assigned equal ranking by QHA) and the top twenty reaches for protection are listed in Table 50.

QHA also ranked the 11 habitat attributes in order of importance for each Reach. The top three ranked attributes are listed for priority restoration reaches in Table 49. These are considered the primary limiting factors to be addressed by restoration projects.

While the priority protection reaches shown in Table 6 were ranked by QHA, this list of reaches is not prioritized. Protection of each of these reaches is considered of equal priority, and actions to protect current habitat value should be taken whenever and wherever the opportunity exists. However, programs focused on implementing passive restoration projects should consider the QHA ranking with respect to project planning, and planners should target the highest ranked reaches first.

Table 49. Priority Reaches for Redband Trout Habitat Restoration in Willow Creek.

Geographic Area	**Geographic Area Description**	**QHA Rank**	**Primary Limiting Factors**
Willow 14	From top of Willow Cr. Reservoir to Skinner Fork	1	Ch Form, Rip Cond, F Sed
Willow 15	Willow Cr., Skinner Fork to North fork	2	Ch Form, Rip Cond, F Sed
Rhea 2	Rhea Cr., McKinney Cr. to Balm Canyon	3	Rip Cond, Poll, Ch Comp
Willow 10	Willow Cr., Lower Heppner to Willow Cr. Dam	4	Rip cond, F Sed, Poll
Balm Can. 1	Balm Canyon, mouth to Road Canyon	5	Rip Cond, Ch Comp, Poll
Willow 3	Weir in mid section 23	6	Obstruction
Willow 9	Willow Cr., Rhea Cr. to lower Heppner	7	Rip Cond, F Sed, Ch Comp
McKinney 2	McKinney Cr., Porcupine Canyon to 3320 ft. level	8	Rip Cond, F Sed, Ch Comp
McKinney 1	Mckinney Cr., mouth to Porcupine Canyon	9	Rip Cond, F Sed, Ch Comp
Rhea 3	Rhea Cr., Balm Canyon to Thorn Cr.	10	Ch Form, Rip Cond, Ch Comp
Eightmile Canyon	Mouth to spring/forks in section 34	11	Poll, L Temp, Rip Cond
Rhea 1	Rhea Cr., mouth to Mckinney Cr.	12	Rip Cond, F Sed, Poll
Road Can.	Mouth to 3000 ft. level	13	Rip Cond, Ch Form, L Flow
Thorn 1	Thorn Cr., mouth to Jug Cr.	14	Ch Form, Rip cond, Ch Comp
NF Willow 2	North Fork Willow Cr., culvert at Willow Cr. Rd. to 4300 ft. level	15	Ch Form, H Flow, Ch Comp
Willow 17	Willow Cr., unnamed tributary in SE corner section 9 to unnamed tributary	16	H Temp, Rip Cond, H Flow
Willow 16	Willow Cr., North fork to unnamed tributary in SE corner section 9	17	Rip Cond, H Flow, L Flow
Rhea 4	Rhea Cr., Thorn Cr. to Rutabaga Cr.	18	Ch Form, Rip Cond, Ch Comp
Willow 2	Willow Cr., from John Day Reservoir to middle section 23	19	Rip Cond, F Sed, Ch Comp
Willow 4	Willow Cr., Weir in middle section 23 to Eightmile canyon	19	Rip Cond, F Sed, Ch Comp
Willow 5	Willow Cr., Eightmile Canyon to weir at section line 1/6	19	Rip Cond, F Sed, Ch Comp
Willow 7	Willow Cr., weir at section1/6 to McNab Rd. Bridge	19	Rip Cond, F Sed, Ch Comp
Willow 8	Willow Cr., McNab Rd. Br. to Rhea Cr.	19	Rip Cond, F Sed, Ch Comp

Table 50. Priority Reaches for Redband Trout Habitat Protection in Willow Creek.

QHA Reach	Geographic Area Description
Rhea 5	Rhea Cr., Rutabaga Cr. to Wilson Cr.
Rhea 6	Rhea Cr., Wilson Cr. to Copple Cr.
Rhea 7	Rhea Cr., Copple Cr. to 4000 ft. level
Willow 16	Willow Cr., North fork to unnamed tributary in SE corner section 9
Rhea 4	Rhea Cr., Thorn Cr. to Rutabaga Cr.
Thorn 2	Thorn Cr., Jug Cr. to 4000 ft. level
Wilson 1	Wilson Cr., mouth to Caplinger Cr.
Caplinger	Caplinger Cr., mouth to 4550 ft. level
Wilson 2	Wilson Cr., Caplinger Cr. unnamed tributary below 3700 ft. level
Wilson Trib 1	Mouth to unnamed tributary below 3700 ft. level
Wilson Trib Trib	Unnamed trib below 3900 ft. level to 4350 ft. level
Wilson Trib 2	Unnamed tributary just below 3700 ft. level to unnamed tributary below 3900 ft. level
Wilson 3	Wilson Cr., Unnamed tributary just below 3700 ft. level to 4500 ft.
Copple	Copple Cr., mouth to 3950 ft. level
Rutabaga	Rutabaga Cr., mouth to 4120 ft. level
Rhea 3	Rhea Cr., Balm Canyon to Thorn Cr.
Balm Canyon 2	Balm Canyon, Road Canyon to 3000 ft. level
NF Willow 2	North Fork Willow Cr., culvert at Willow Cr. Rd. to 4300 ft. level
Willow 18	Willow Cr., unnamed tributary in NE corner section 36 to Shaw Cr.
Willow 17	Willow Cr., unnamed tributary in SE corner section 9 to unnamed trib

The results of the limiting factors analysis reveal that many of the same factors impact the different focal species in both the Umatilla River and its tributaries and Willow Creek and its tributaries. In summary, in the Umatilla/Willow subbasin the factors most important in limiting the survival of steelhead, spring Chinook, fall Chinook, and coho are high water temperature, sediment load, habitat diversity, and the quantity of appropriate habitat. Similar limiting factors are important for bull trout in the Umatilla River subbasin, and these are habitat diversity, habitat quantity, and high temperatures. Finally, redband trout in the Willow Creek subbasin are limited mainly by habitat quantity, habitat diversity, and sediment.

In the subbasin, high water temperatures result from low flows, lack of riparian vegetation, lack of groundwater exchange, and channel form. Sediment load results from upland erosion and runoff, bank erosion and downcutting of stream channels; these factors can be ameliorated by improving upland practices and restoring proper riparian function and the connection between the channel and its floodplain. The lack of appropriate habitat diversity reflects the loss of woody debris throughout much of the subbasin. As with temperature and sediment, the restoration of good riparian function provides a long-term solution to this limiting factor. Finally, the lack of enough appropriate habitat reflects a lack of pool habitat and gravel dominated riffles. This effect stems mostly from poor channel form and function resulting from straightened and incised channels.

Appendix E shows a detailed breakdown of the limiting factors by GA for each species (pages 23-26) and by species within each GA (pages 27-116). In addition to the limiting factors, the attributes contributing to the limiting factors are also shown.

3.5.1.4 Priority Reaches for Restoration and Protection – Areas in Which Human Intervention can Enhance Focal Species Populations

As stated above, both EDT and QHA prioritize geographic areas or reaches based on their importance to the focal species being examined. EDT ranks geographic reaches based on their priority for restoration and their priority for protection. A high restoration ranking indicates that with improvements to habitat, water quality, and/or passage with on-the-ground projects a relatively large increase in abundance and/or productivity of a given focal species will occur. A high protection ranking indicates that any further degradation to that geographic area will result in large decreases in current abundance and/or productivity; therefore efforts should be made to protect that area and maintain it at its current state. In both restoration and protection cases, ranking is based upon the relative impact on salmonid populations that actions in that geographic area will have. The relative contributions resulting from restoration or from further degradation for coho, steelhead, spring Chinook, and fall Chinook are shown in figures 132-135. These figures show two methods of ranking the GAs. The "Category" column is a ranking based on four groups: "A" indicates high priority, "B" and "C" indicate medium piority, and "D" indicates low priority. The "rank" column is an actual numeric ranking from 1 (top priority) to N (where N is the largest number and indicates the lowest priority).

Umatilla Coho

Relative Importance Of Geographic Areas For Protection and Restoration Measures

Geographic Area	Protection benefit Category/rank		Restoration benefit Category/rank	
GA1	D	24	C	12
GA11	D	22	A	10
GA12	C	14	A	8
GA13	D	20	C	15
GA14	A	2	D	19
GA15	C	12	C	13
GA17	A	3	C	17
GA18	A	4	D	21
GA19	A	9	C	13
GA2	D	21	A	3
GA20	D	21	D	22
GA21	D	18	A	8
GA22	D	20	C	16
GA24	A	5	C	14
GA25	D	17	A	6
GA26	D	24	A	8
GA28	A	6	A	4
GA3	D	19	D	25
GA30	C	15	C	18
GA31	A	6	C	18
GA32	A	8	D	20
GA33	A	2	A	9
GA35	A	7	D	22
GA4	D	21	A	7
GA40	A	1	C	11
GA42	A	10	D	24
GA43	C	12	D	23
GA46	D	23	D	26
GA5	D	16	A	1
GA7	C	13	A	5
GA8	C	11	A	3
GA9	D	17	A	2

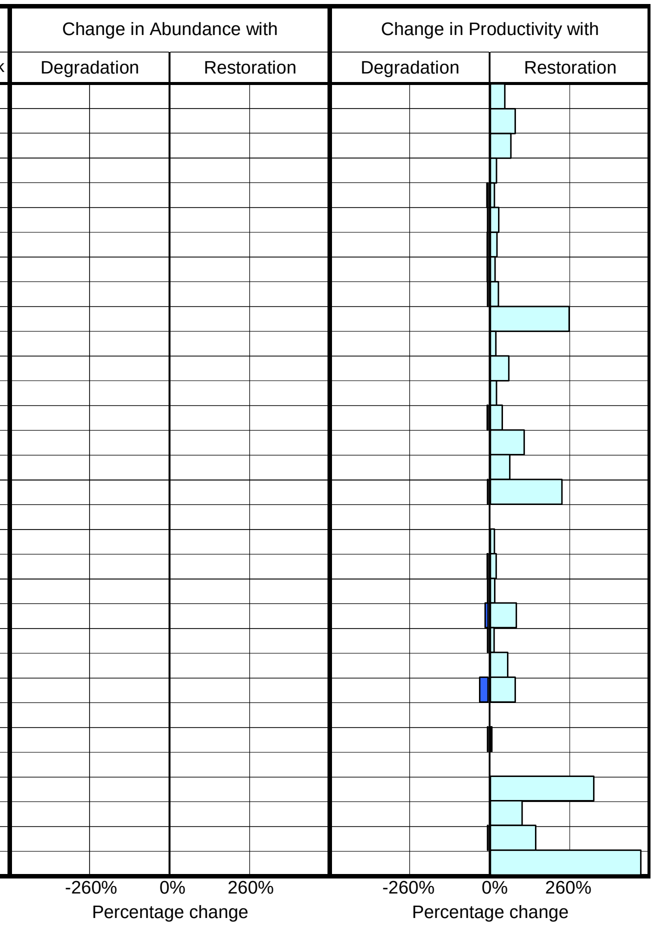

Figure 132. Priority ranking of reaches and the relative contributions of degradation and restoration for fall Chinook.

Umatilla Summer Steelhead

Relative Importance Of Geographic Areas For Protection and Restoration Measures

Geographic Area	Protection benefit		Restoration benefit	
	Category/rank		Category/rank	
GA1	D	19	D	23
GA11	D	29	E	32
GA12	D	20	A	1
GA13	E	32	A	8
GA14	A	9	D	19
GA15	C	14	A	6
GA16	C	15	E	29
GA17	D	24	C	14
GA18	C	11	C	17
GA19	A	5	C	12
GA2	C	12	C	18
GA20	D	21	C	13
GA21	E	38	A	7
GA22	E	38	E	35
GA24	E	38	E	35
GA25	D	26	E	30
GA26	E	33	E	34
GA27	D	28	C	11
GA28	D	17	A	3
GA29	E	31	C	13
GA3	E	31	E	33
GA30	D	25	D	24
GA31	D	30	D	25
GA32	D	22	A	9
GA33	A	9	A	5
GA34	D	16	D	20
GA35	A	4	A	10
GA36	C	13	A	7
GA37	A	8	E	27
GA38	D	23	D	26
GA39	D	25	E	28
GA4	E	37	C	15
GA40	A	2	A	4
GA41	D	18	E	31
GA42	A	1	C	15
GA43	A	7	C	15
GA44	A	3	D	22
GA45	A	9	C	17
GA46	A	6	D	23
GA5	E	35	A	2
GA6	D	27	C	16
GA7	E	36	D	25
GA8	E	34	D	21
GA9	A	10	C	15

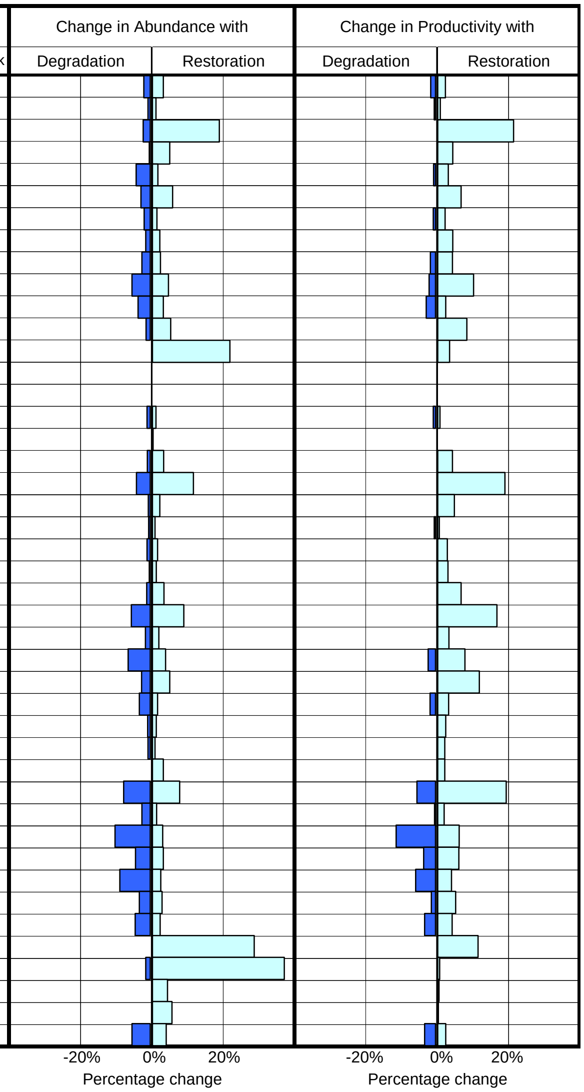

Figure 133. Priority ranking of reaches and the relative contributions of degradation and restoration for steelhead.

Umatilla Spring Chinook

Relative Importance Of Geographic Areas For Protection and Restoration Measures

Geographic Area	Protection benefit		Restoration benefit	
	Category/rank		Category/rank	
GA1	C	14	C	18
GA11	C	12	C	15
GA12	C	15	A	3
GA13	D	18	A	10
GA17	A	8	A	6
GA18	A	6	C	13
GA2	C	11	C	11
GA20	A	6	A	8
GA21	D	17	A	2
GA24	A	9	A	6
GA25	A	10	A	7
GA28	A	7	A	1
GA3	D	16	D	19
GA31	A	9	C	12
GA32	C	13	C	15
GA33	A	3	A	4
GA35	A	2	A	9
GA40	A	1	A	5
GA42	A	4	C	17
GA43	A	4	C	14
GA46	A	6	C	16
GA9	A	5	A	10

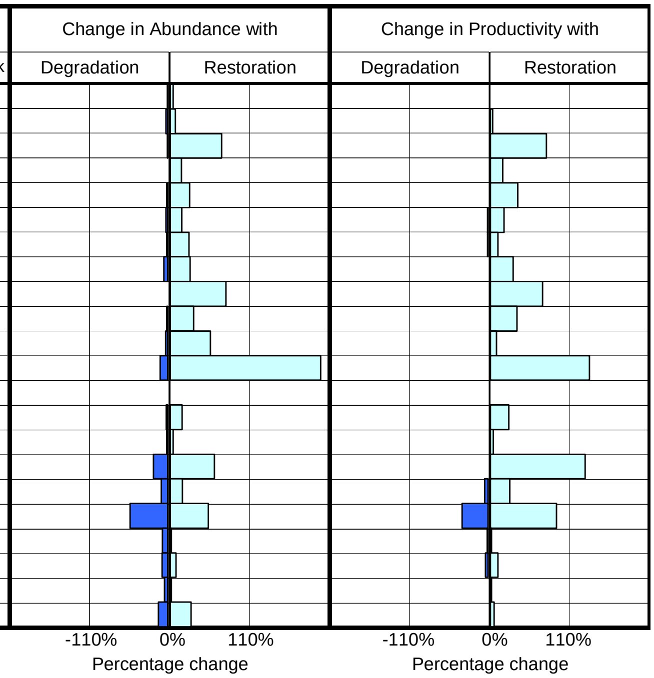

Figure 134. Priority ranking of reaches and the relative contributions of degradation and restoration for spring Chinook.

Umatilla Fall Chinook

Relative Importance Of Geographic Areas For Protection and Restoration Measures

Geographic Area	Protection benefit		Restoration benefit	
	Category/rank		Category/rank	
GA1	E	11	A	4
GA11	A	9	A	5
GA12	A	7	A	6
GA2	A	10	A	3
GA20	A	5	A	9
GA21	A	4	A	7
GA25	A	6	A	5
GA28	A	2	A	2
GA3	A	9	A	10
GA33	A	3	A	7
GA40	A	1	A	8
GA9	A	8	A	1

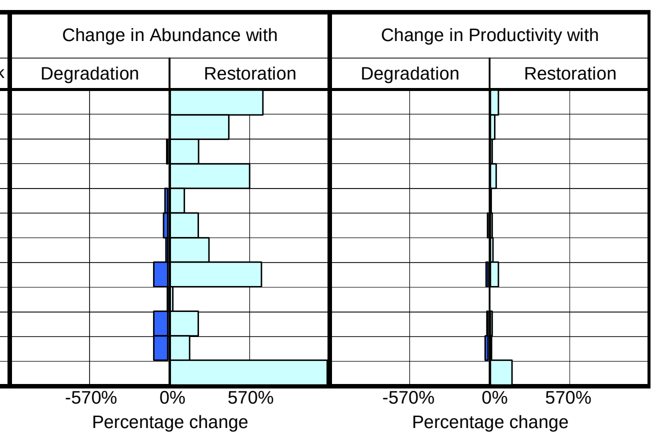

Figure 135. Priority ranking of reaches and the relative contributions of degradation and restoration for fall Chinook.

EDT ranks all geographic areas in which a particular species was present historically, regardless of its current status. From this list an arbitrary number of the top ranked reaches were selected as for each species for both restoration and protection. The aquatic work group determined that the following number of reaches would be selected for restoration and protection of habitat separately: 15 each for steelhead, 10 each for spring Chinook, 10 each for coho and 5 each for fall Chinook. The arbitrary number of reaches for each species was selected based on the extent of distribution of each species. The species with the broadest distribution, steelhead, has the most GAs targeted for restoration and protection and the species with the smallest distribution, fall Chinook, has the least number of GAs selected.

As stated above, EDT examines all geographic areas in which a species was historically present, regardless of its current status. From this, a perspective of historic production by each of the EDT focal species and geographic area was gained. However, significant portions of the Umatilla/Willow subbasin are no longer habitat for anadromous fish such as McKay Creek, which is blocked to passage by McKay Dam, and Butter Creek, which is blocked by numerous passage barriers and severe water withdrawal. McKay Dam is a complete passage barrier to fish and the severity of passage conditions in Butter Creek is not fully understood as a comprehensive survey has not been conducted in that region. While many reaches that are blocked to anadromous fish use in McKay and Butter creeks ranked high for protection or restoration, these reaches are not included as priority areas as restoring these systems is not at this time economically or socially feasible. In addition, other reaches were removed from consideration as current priorities for reasons such as current lack of use of the species, Wilderness Areas being ranked high for restoration, etc. Reaches that ranked high for either restoration or protection, but are not identified as current priorities are shown in Appendix E (pages 117-119) along with the rationale. Therefore, our ranking of priority reaches does not necessarily completely coincide with EDT rankings (e.g., see table 136).

EDT focal species priority restoration and protection GAs are shown in Tables 136 through 143. Restoration areas were prioritized by rank, but protection areas are considered to be equal in priority. Loss of productive capacity through degradation of any of the priority protection areas, while restoration is actively pursued in other areas, is considered of equal importance for all priority protection GAs because any significant loss in current abundance and/or productivity is considered equally important to address. While the Priority restoration areas are ranked, this ranking is considered preliminary and draft in nature. As discussed elsewhere, a number of problems are known to exist with EDT inputs. Thus, outputs of the model are not necessarily expected to be accurate and precise. The current plan of the aquatic working group is to continue to conduct EDT analyses through the summer of 2004 to fine tune the model and the data and to conduct additional restoration scenarios. It is anticipated that by the fall of 2004, EDT outputs with a higher quality/confidence level will be incorporated into the subbasin plan.

Table 136. Priority Geographic Areas for Coho Habitat Restoration

Geographic Area	Geographic Area Description	EDT Rank	Restoration Priority
GA 9	Umatilla R., Butter Cr. to Westland Dam & Stanfield Dam to McKay Cr.	2	1
GA 28	Umatilla R., Mission Bridge to Meacham Cr.	4	2
GA 25	Umatilla R., McKay Cr. to Mission Bridge	6	3
GA 26	Wildhorse Cr., mouth to Athena including tributaries	8	4
GA 33	Meacham Cr., mouth to North fork	9	5
GA 11	Umatilla R., Westland Dam to Stanfield Dam	10	6
GA 40	Umatilla R., Meacham Cr. to forks including all tributaries except Ryan Creek	11	7

Table 137. Priority Geographic Areas for Coho Habitat Protection

Geographic Area	Geographic Area Description	EDT Rank
GA 40	Umatilla R., Meacham Cr. to forks including all tributaries except Ryan Creek	1
GA 31	Squaw Cr., mouth to Bachelor Canyon	6
GA 35	North Fork Meacham Cr. and tributaries	7
GA 32	Squaw Cr., Bachelor Canyon to headwaters including tributaries	8
GA 42	North Fork Umatilla R., mouth to headwaters including tributaries	10
GA 12	Birch Cr., mouth to Forks including Stewart Cr.	14
GA 30	Buckaroo Cr.	15

Table 138. Priority geographic areas for steelhead habitat restoration.

Geographic Area	Geographic Area Description	EDT Rank	Restoration Priority
GA 12	Birch Cr., mouth to Forks including Stewart Cr.	1	1
GA 28	Umatilla R., Mission Bridge to Meacham Cr.	3	2
GA 40	Umatilla R., Meacham Cr. to forks including all tributaries except Ryan Creek	4	3
GA 33	Meacham Cr., mouth to North fork	5	4
GA 15	West Birch Cr., Bear Cr. to top of gorge, including tributaries	6	5
GA 13	West Birch Cr., mouth to Bear Cr.	8	6
GA 32	Squaw Cr., Bachelor Canyon to headwaters including tributaries	9	7
GA 35	North Fork Meacham Cr. and tributaries	10	8
GA 19	East Birch Cr., Pearson Cr. to headwaters including Pearson Cr.	12	9
GA 17	East Birch Cr., mouth to California Gulch	14	10
GA 18	East Birch Cr., California Gulch to Pearson Cr.	17	11
GA 14	Bear Cr. and tributaries (West Birch)	19	12
GA 34	Meacham, tributaries from mouth to North fork	20	13
GA 30	Buckaroo Creek	24	14
GA 38	Meacham Cr., Sheep Cr. to Headwaters	26	15

Table 139. Priority geographic areas for steelhead habitat protection.

Geographic Area	Geographic Area Description	EDT Rank
GA 42	North Fork Umatilla R., mouth to headwaters including tributaries	1
GA 40	Umatilla R., Meacham Cr. to forks including all tributaries except Ryan Creek	2
GA 44	Buck Cr. and tributaries	3
GA 35	North Fork Meacham Cr. and tributaries	4
GA 19	East Birch Cr., Pearson Cr. to headwaters including Pearson Cr.	5
GA 46	South Fork Umatilla R., Thomas Cr. to headwaters including Shimmiehorn Cr.	6
GA 43	South Fork Umatilla R., mouth to Thomas Cr.	7
GA 37	East Meacham Cr. and Butcher Creek and tributaries	8
GA 45	Thomas Cr. and tributaries (South Fork Umatilla)	9
GA 9	Umatilla R., Butter Cr. to Westland Dam & Stanfield Dam to McKay Cr.	10
GA 18	East Birch Cr., California Gulch to Pearson Cr	11
GA 2	Umatilla R., Three Mile Dam to Butter Cr.	12
GA 36	Meacham Cr., North fork to Sheep Creek	13
GA 15	West Birch Cr., Bear Cr. to top of gorge, including tributaries	14
GA 16	West Birch Cr., gorge to headwaters	15

Table 140. Priority geographic areas for spring Chinook habitat restoration

Geographic Area	Geographic Area Description	EDT Rank	Restoration Priority
GA 28	Umatilla R., Mission Bridge to Meacham Cr.	1	1
GA 33	Meacham Cr., mouth to North fork	4	2
GA 40	Umatilla R., Meacham Cr. to forks including all tributaries except Ryan Creek	5	3
GA 25	Umatilla R., McKay Cr. to Mission Bridge	7	4
GA 35	North Fork Meacham Cr. and tributaries	9	5
GA 9	Umatilla R., Butter Cr. to Westland Dam & Stanfield Dam to McKay Cr.	10	6
GA 2	Umatilla R., Three Mile Dam to Butter Cr.	11	7
GA 31	Squaw Cr., mouth to Bachelor Canyon	12	8
GA 43	South Fork Umatilla R., mouth to Thomas Cr.	14	9
GA 11	Umatilla R., Westland Dam to Stanfield Dam	15	10

Table 141. Priority geographic areas for spring Chinook habitat protection.

Geographic Area	Geographic Area Description	EDT Rank
GA 40	Umatilla R., Meacham Cr. to forks including all tributaries except Ryan Creek	1
GA 35	North Fork Meacham Cr. and tributaries	2
GA 33	Meacham Cr., mouth to North fork	3
GA 42	North Fork Umatilla R., mouth to headwaters including tributaries	4
GA 43	South Fork Umatilla R., mouth to Thomas Cr.	4
GA 9	Umatilla R., Butter Cr. to Westland Dam & Stanfield Dam to McKay Cr.	5
GA 46	South Fork Umatilla R., Thomas Cr. to headwaters including Shimmiehorn Cr.	6
GA 28	Umatilla R., Mission Bridge to Meacham Cr.	7
GA 25	Umatilla R., McKay Cr. to Mission Bridge	10
GA 2	Umatilla R., Three Mile Dam to Butter Cr.	11
GA 11	Umatilla R., Westland Dam to Stanfield Dam	12

Table 142. Priority geographic areas for fall Chinook habitat restoration.

Geographic Area	Geographic Area Description	EDT Rank	Restoration Priority
GA 9	Umatilla R., Butter Cr. to Westland Dam & Stanfield Dam to McKay Cr.	1	1
GA 28	Umatilla R., Mission Bridge to Meacham Cr.	2	2
GA 2	Umatilla R., Three Mile Dam to Butter Cr.	3	3
GA 11	Umatilla R., Westland Dam to Stanfield Dam	5	4

Table 143. Priority geographic areas for fall Chinook habitat protection.

Geographic Area	Geographic Area Description	EDT Rank
GA 40	Umatilla R., Meacham Cr. to forks including all tributaries except Ryan Creek	1
GA 28	Umatilla R., Mission Bridge to Meacham Cr.	2
GA 33	Meacham Cr., mouth to North fork	3
GA 25	Umatilla R., McKay Cr. to Mission Bridge	6
GA 12	Birch Cr., mouth to Forks including Stewart Cr.	7

To simplify the priority listing of GAs and to make sure that the ESA listed species, bull trout, was given equal consideration with steelhead (the other listed species), the priority reaches for bull trout generated by QHA have been incorporated into priority GAs for steelhead and salmon generated by EDT. This combining makes sense, many of the same factors that limit steelhead and salmon (particularly habitat diversity and habitat quantity) also limit bull trout and it allows, in a very simple fashion, to identify priority areas that contain both listed species. The priority GAs for bull trout restoration and protection are shown in tables 144 and 145, respectively.

Table 146 shows GAs that are high restoration priority for multiple species. These areas, particularly the two GAs (33 and 40) that are priority for both listed species, bull trout and steelhead, will be given high consideration for restoration, and perhaps the highest. This makes sense given the individual high priority of the two shared areas for each species. GA 40 (the Umatilla River from Meacham Creek confluence to the forks and including all tributaries except Ryan Creek) received the highest priority for bull trout and was ranked 4th for steelhead shared by these species. GA 33 (Meacham Creek, from the mouth to the North Fork) was ranked 2nd in priority for bull trout and 5th for steelhead.

Table 144. Priority Geographic Areas for Bull Trout Habitat Restoration

Geographic Area	**Geographic Area Description**	**Restoration Priority**
GA 40	Umatilla R., Meacham Cr. to forks including all tributaries except Ryan Creek	1
GA 33	Meacham Cr., mouth to North fork	2

Table 145. Priority geographic areas for bull trout habitat protection.

Geographic Area	**Geographic Area Description**	**Restoration Priority**
GA 42	North Fork Umatilla, mouth to headwaters including tributaries	1
GA 40	Umatilla R., Meacham Cr. to forks including all tributaries except Ryan Creek	2
GA 35	North Fork Meacham Cr. and tributaries	3

Table 146. Geographic areas with restoration priority for multiple species. Areas highlighted in blue contain both ESA listed species, bull trout and steelhead. ChF = fall Chinook, ChS = spring Chinook, Co = coho, StS = summer steelhead, and BT = bull trout.

Geographic Area	Geographic Area Description	Species
GA 2	Umatilla R., Three Mile Dam to Butter Cr.	ChF, ChS
GA 9	Umatilla R., Butter Cr. to Westland Dam & Stanfield Dam to McKay Cr.	ChF, Co, ChS
GA 11	Umatilla R., Westland Dam to Stanfield Dam	ChF, Co, ChS
GA 28	Umatilla R., Mission Bridge to Meacham Cr.	ChF, Co, ChS, StS
GA 33	Meacham Cr., mouth to North fork	BT, Co, ChS, StS
GA 35	North Fork Meacham Cr. and tributaries	ChS, StS
GA 40	Umatilla R., Meacham Cr. to forks including all tributaries except Ryan Creek	BT, Co, ChS, StS

QHA also provided ranking of reaches in terms of restoration and protection for redband trout in Willow Creek and its tribuatries. While the QHA tool is less rigorous than EDT, it at least provides a method for prioritization of efforts. Prioritization of reaches for restoration and protection of redband trout habitat are listed in Tables 147 and 148, respectively.

Table 147. Priority reaches for restoration of redband trout habitat in Willow Creek and its tributaries.

Reach	Reach Description	QHA Priority
Willow 14	Top of Reservoir to Skinner Fork	1
Willow 15	Skinner Fork to North Fork	2
Rhea 2	McKinney Cr. to Balm Canyon	3
Willow 10	Lower Heppner to Willow Cr. Dam	4
Balm Canyon 1	Mouth at Rhea Cr. to Road Canyon	5
Willow 3	Weir in the middle of section 23	6
Willow 9	Rhea Cr. to lower Heppner	7
McKinney 2	Porcupine Canyon to 3320 ft. elevation	8
McKinney 1	Mouth at Rhea Cr. to Porcupine Canyon	9
Rhea 3	Balm Canyon to Thorn Cr.	10
Eightmile Canyon	Mouth at Willow Cr. to Spring/Forks in section 34	11
Rhea 1	Mouth at Willow Cr. to McKinney Cr.	12
Road Canyon	Mouth at Balm Canyon to 3000 ft. elevation	13
Thorn Cr. 1	Mouth at Rhea Cr. to Jug Cr.	14
NF Willow 2	Mouth/culvert of Willow Cr. Road to 4300 ft. elevation	15
Willow 16	NF to unnamed trib in SE corner of section 9	17
Rhea 4	Thorn Cr. to Rutabaga Cr.	18
Willow 2	Top of bay to weir in the middle of section 23	19
Willow 4	Weir in the middle of section 23 to Eightmile Canyon	19
Willow 5	Eightmile Canyon to weir at section line 1/6	19
Willow 7	Weir at section line 1/6 to McNab Road Bridge	19
Willow 8	McNab Road Bridge to Rhea Cr.	19

Table 148. Priority reaches for protection of redband trout habitat in Willow Creek and its tributaries.

Reach	Reach Description	QHA Priority
Rhea 5	Rutabaga Cr. to Wilson Cr.	1
Rhea 6	Wilson Cr. to Copple Cr.	2
Rhea 7	Copple Cr. to 4000 ft. elevation	3
Willow 16	NF to nnnamed trib. in SE corner of section 9	4
Rhea 4	Thorn Cr. to Rutabaga Cr.	5
Thorn 2	Jug Cr. to 4000 ft. elevation	6
Wilson 1	Mouth at Rhea Cr. to Caplinger Cr.	6
Caplinger	Mouth at Wilson Cr. to 4550 ft. elevation	6
Wilson 2	Caplinger Cr. to unnamed trib. below 3700 ft. elevation	6
Wilson Trib 1	Unnamed trib to unnamed trib. below 3900 ft. elevation	6
Wilson Trib trib	Unnamed trib below 3900 ft. elevation to 4350 ft. elevation	6
Wilson Trib 2	Unnamed trib below 3700 ft. elevation to unnamed trib. below 3900 ft. elevation	6
Wilson 3	Unnamed trib. below 3700 ft. elevation to 4500 ft. elevation	6
Copple	Mouth at Rhea Cr. to 3950 ft. elevation	6
Rutabaga	Mouth at Rhea Cr. to 4120 ft. elevation	15
Rhea 3	Balm Canyon to Thorn Cr.	16
Balm Canyon 2	Road Canyon to 3000 ft. elevation	17
NF Willow 2	Mouth/culvert at Willow Cr. road to 4300 ft. elevation	18
Willow 18	Unnamed trib. in NE corner of section 16 to Shaw Cr.	19
Willow 17	Unnamed trib. in SE corner of section 9 to unnamed trib.	20

3.5.2 Factors Leading to the Decline of Terrestrial Focal Species and Habitats

Although wildlife species can be strongly affected by non-anthropogenic disturbances in certain circumstances, most declines in wildlife species and destruction and degradation of habitat in the Umatilla/Willow subbasin are directly related to human activity within the subbasin. Descriptions of important human activities that occur in the subbasin and their general effect on the ecology of the subbasin are described in Sections 3.1.1.9 and 3.1.3.2. Information from those sections and from Appendices C and D were combined to create the following lists of limiting factors for each habitat type. It should be noted the term "limiting factor" is used more generally in the wildlife assessment than in the aquatic assessment. Limiting factors for wildlife are generally described in terms of activities or conditions that are believed to negatively impact wildlife primarily through their effect on habitat (e.g., timber harvest, the invasion of exotic vegetation). These activities or conditions are believed to impact focal and obligate wildlife species via a variety of mechanisms that affect key environmental correlates.

Mixed Conifer Forest: The quality of mixed conifer forest in the Umatilla/Willow subbasin is believed to have declined due to timber harvest, altered fire regimes, ponderosa pine encroachment, development, outbreaks of western spruce budworm and Douglas-fir tussock moth, and exotic plant invasion. These factors have resulted in direct loss of old growth habitat and fragmentation and degradation of remaining mixed conifer forest. Loss of old growth habitat has occurred primarily because of timber harvesting, while habitat degradation is primarily associated with altered fire regimes. Fire suppression has promoted less fire-resistant, shade-tolerant trees, and led to mixed conifer forests with low snag density, high tree density, and stands dominated by smaller and more shade-tolerant trees.

Ponderosa Pine Forest: The quality of ponderosa pine forest habitat is believed to have declined due to mixed forest encroachment, altered fire regimes and stand-replacing fires, timber harvest, exotic plant invasion, outbreaks of western spruce budworm and Douglas-fir tussock moth, livestock grazing, development, and recreational activities (see Section 3.5.2 for more description). Two of the major factors responsible for habitat loss and degradation of functional ponderosa pine forest are harvest of late and old structure pine and the encroachment of Douglas-fir and grand fir into ponderosa pine dominated habitats. The encroachment is due primarily to fire suppression and intense, stand-replacing wildfires; the latter results from high fuel loads associated with increases in brushy species and the establishment of ladder fuels from encroaching shade tolerant understory trees.

Quaking Aspen Forest: The major factors affecting aspen habitat in the Umatilla/Willow subbasin are intensive grazing by livestock and native ungulates, fire suppression, and the invasion of coniferous species.

Western Juniper Woodlands: The most important limiting factors of juniper woodlands, especially of mature trees or stands associated with shrub-steppe or grasslands, are agricultural conversion, altered fire regimes, overgrazing, and exotic plant invasions.

Shrub-Steppe: Major factors affecting both low and higher elevation shrub-steppe habitat in the Umatilla/Willow subbasin are agricultural conversion (including the conversion of CRP lands back into croplands), exotic plant invasion, alteration of fire regimes, purposeful seeding of non-native grasses, and livestock grazing (see Section 3.6.2). These factors result in habitat loss, fragmentation, and degradation. Historically, the single largest factor responsible for shrub-steppe habitat loss in the Umatilla/Willow subbasin is conversion to agriculture. Remaining shrub-steppe habitat continues to be threatened by agricultural conversion, but of even greater concern is the proliferation of exotic weeds. Cheatgrass is especially problematic, as described in Section 3.1.1.9, because it increases the frequency and severity of range fires, which can lead to the replacement of sagebrush, bitterbrush, and other native shrubs with cheatgrass. The invasion of exotic plants is facilitated by the loss of cryptogamic crusts resulting from soil disturbances associated with tillage and inappropriate livestock grazing practices. Non-native animal species, including nest competitors (e.g., European Starlings, House Sparrow), nest parasites (e.g., Brown Headed Cowbirds), and domestic predators (e.g., cats, dogs) also negatively affect obligate species in this habitat. The effects of non-native species are magnified by habitat fragmentation. Additionally, shrub-steppe habitats in proximity to agricultural, recreational, and residential areas may be subject to high levels of human disturbance.

Interior Grasslands: Major factors affecting grassland habitat in the Umatilla/Willow subbasin are agricultural conversion (including the conversion of CRP back into cropland), exotic weed invasion, purposeful seeding of non-native grasses, overgrazing, and human-altered fire regimes. These factors result in direct habitat loss, fragmentation, and degradation. The single largest factor in habitat loss is conversion to agriculture. The largest factor in habitat degradation is the proliferation of annual grasses and exotic weeds, such as cheatgrass and yellow starthistle, which either replace or radically alter native bunchgrass communities. This invasion of exotic plants is facilitated by the loss of cryptogamic crusts, resulting from soil disturbances associated with tillage and livestock grazing. Non-native animal species, including nest competitors (e.g., European Starlings, House Sparrow), nest parasites (e.g., Brown Headed Cowbirds), and domestic predators (e.g., cats, dogs) also impact native species productivity. The effects of non-native species are magnified by habitat fragmentation. Additionally, grassland habitats in proximity to agricultural and recreational areas may be subject to high levels of human disturbance.

Herbaceous Wetlands: Major factors that have led to the destruction and degradation of herbaceous wetlands in the Umatilla/Willow subbasin are habitat conversion and draining, lowering of ground water level, separation of floodplain from the stream channel due to dikes and levees, exotic plant and animal invasions, and livestock grazing.

Riparian Wetlands: Major factors affecting riparian wetlands in the Umatilla/Willow subbasin are agricultural and urban development, exotic weed invasion, timber harvest, livestock grazing, transportation corridors, hydropower, and recreational activities. Hydropower, agricultural, urban, and transportation corridor development have led to habitat loss through conversion and channelization, have resulted in the separation of the floodplain from the stream, and have contributed to the degradation and fragmentation of remaining riparian habitat. Most of the extensive cottonwood galleries once found in riparian wetlands of the subbasin have been harvested. Existing riparian wetlands also continue to be degraded by exotic plant invasions and livestock grazing.

3.6 Synthesis and Interpretation

3.6.1 Aquatic Focal Species Synthesis and Interpretation

3.6.1.1 Restoration Scenarios and Working Hypotheses

Based on the EDT results, the aquatic working group determined that the important limiting factors could be addressed through habitat restoration and implementation of Phase III of the Umatilla Basin Project. Implementation of Phase III will involve increased instream flows in the mainstem from Thornhollow (RM 73.5) to the mouth and will impact GAs 1, 2, 9, 11, 25, and 28. Each of these actions should result in lower water temperatures, increased passage survival, and increased habitat quantity. Habitat restoration (based on specific habitat objectives and strategies that are outlined in the Management Plan) should also address sediment loads and habitat complexity. From this, three restoration scenarios were examined with EDT:

1) Habitat restoration of the top priority geographic areas singly plus the implementation of Phase III of the Umatilla Basin Project.
2) Habitat restoration of the top 19 geographic areas plus implementation of Phase III.
3) Habitat restoration of the top 19 geographic areas with no implementation of Phase III.

The impact of each of these scenarios on the anadromous focal species was determined through EDT. EDT output provides a working hypothesis on the impact that each scenario has on the productivity and abundance of steelhead and salmon.

Working Hypotheses

***Steelhead* –** EDT estimate of current abundance = 2,650 adults and productivity = 4.9

1) Restoration of the top priority geographic area (the area ranked 1) plus the implementation of Phase III will result in no impact on productivity and an increase in returning adult abundance by approximately 2% (adult abundance = 2,705).

2) Restoration of the top 19 priority geographic areas plus implementation of Phase III will result in an increase of productivity by 43% (a value of 7.0) and an increase in returning adult abundance by approximately 36% (an abundance of 3,610 adults).

3) Restoration of the top 19 priority geographic areas with no Phase III will result in an increase in productivity by 37% (a value of 6.7) and an increase in returning adult abundance by approximately 30% (an abundance of 3,443 adults).

These results are shown graphically in figures 149 and 150.

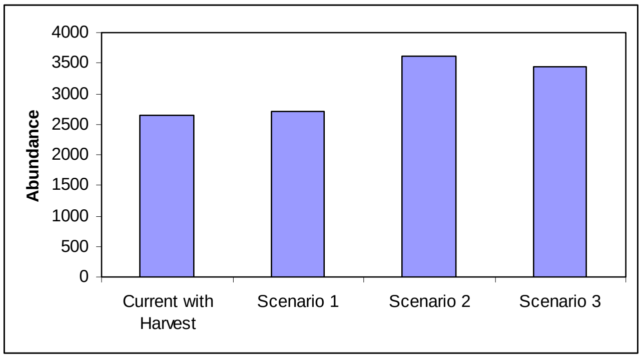

Figure 149. EDT estimate of current abundance and results showing the impacts on abundance of adult steelhead under the three restoration scenarios.

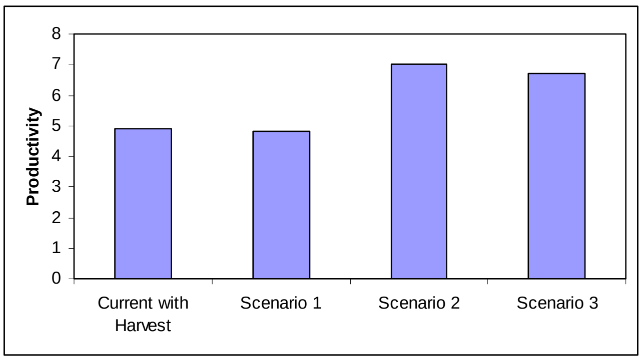

Figure 150. EDT estimate of current productivity and results showing the impacts on productivity of the steelhead population under the three restoration scenarios.

Spring Chinook – EDT estimate of current abundance = 440 adults and productivity= 2.3

1) Restoration of the top priority geographic area (the area ranked 1) plus the implementation of Phase III will result in an increase in productivity by 42% (a value of 3.4) and an increase in returning adult abundance by approximately 152% (adult abundance = 1,108).

2) Restoration of the top 19 priority geographic areas plus implementation of Phase III will result in an increase of productivity by 100% (a value of 4.6) and an increase in returning adult abundance by approximately 287% (an abundance of 1,702 adults).

3) Restoration of the top 19 priority geographic areas with no Phase III will result in an increase in productivity by 83% (a value of 4.2) and an increase in abundance of returning adults by approximately 127% (an abundance of 998 adults).

These results are shown graphically in figures 151 and 152.

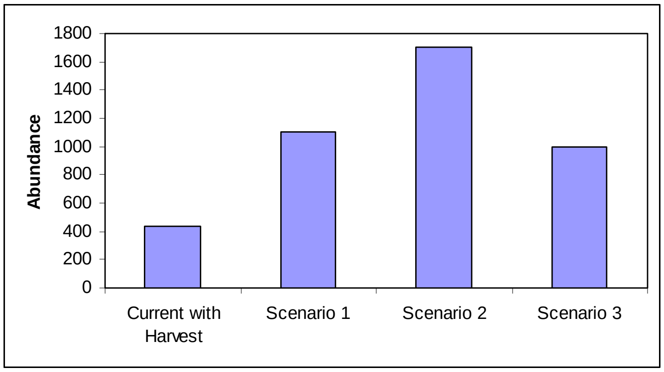

Figure 151. EDT estimate of current abundance and results showing the impacts on abundance of adult spring Chinook under the three restoration scenarios.

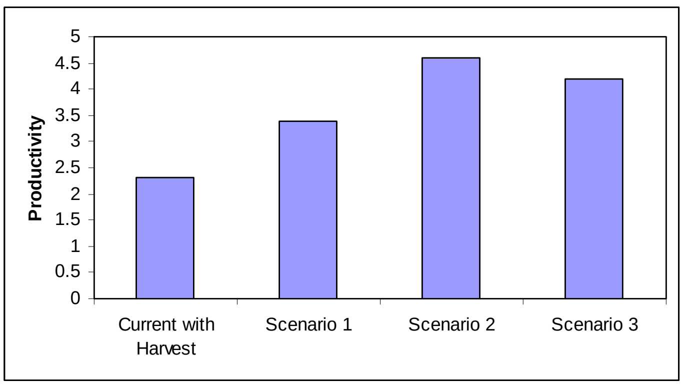

Figure 152. EDT estimate of current productivity and results showing the impacts on productivity of the spring Chinook population under the three restoration scenarios.

***Fall Chinook* –** EDT estimate of current abundance = 0 adults and productivity = 0.4

1) Restoration of the top priority geographic area (the area ranked 1) plus the implementation of Phase III will result in an increase in productivity by 200% (a value of 1.2) and an increase in returning adult abundance to approximately 1,457 fish.

2) Restoration of the top 19 priority geographic areas plus implementation of Phase III will result in an increase of productivity by 350% (a value of 1.8) and an increase in returning adult abundance to approximately 4,192 fish.

3) Restoration of the top 19 priority geographic areas with no Phase III will result in an increase in productivity by 275% (a value of 1.5) and an increase in abundance of returning adults to approximately 3,005 fish.

These results are shown graphically in figures 153 and 154.

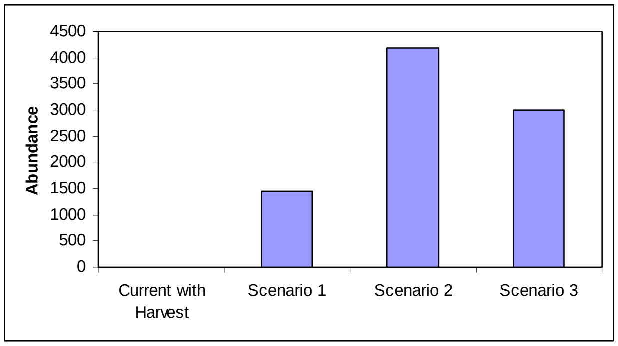

Figure 153. EDT estimate of current abundance and results showing the impacts on abundance of adult fall Chinook under the three restoration scenarios.

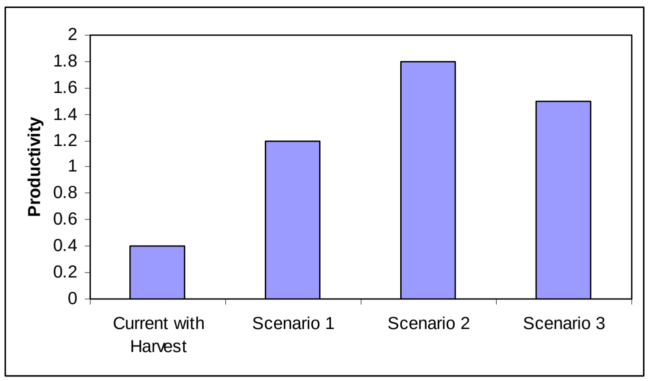

Figure 154. EDT estimate of current productivity and results showing the impacts on productivity of the fall Chinook population under the three restoration scenarios.

Coho **–** EDT estimate of current abundance = 0 adults and productivity = 0.4

1) Restoration of the top priority geographic area (the area ranked 1) plus the implementation of Phase III will result in an increase in productivity by 25% (a value of 0.5); however, the number of adult returns will continue to be so small as to be negligible (i.e., recognized as 0 by EDT).

2) Restoration of the top 19 priority geographic areas plus implementation of Phase III will result in an increase of productivity by 150% (a value of 1.0) and an increase in returning adult abundance to approximately 69 fish.

3) Restoration of the top 19 priority geographic areas with no Phase III will result in an increase in productivity by 125% (a value of 0.9); however, the number of adult returns will continue to be so small as to be negligible (i.e., recognized as 0 by EDT).

These results are shown graphically in figures 155 and 156.

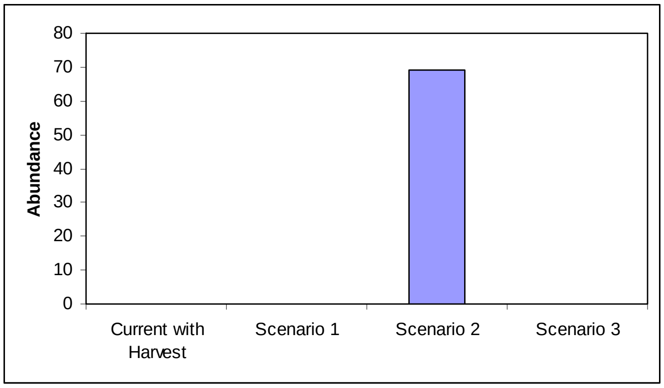

Figure 155. EDT estimate of current abundance and results showing the impacts on abundance of adult coho under the three restoration scenarios.

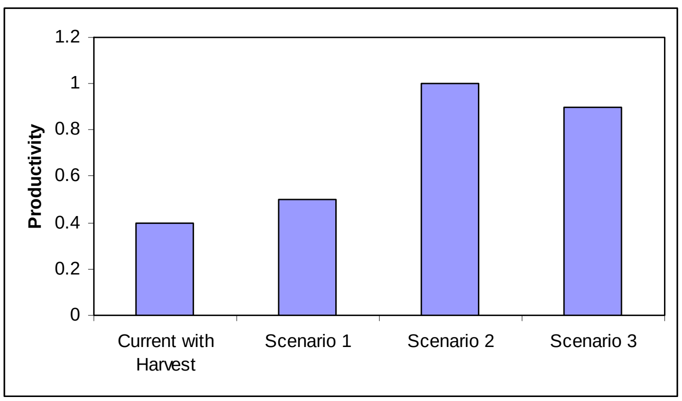

Figure 156. EDT estimate of current productivity and results showing the impacts on productivity of the coho population under the three restoration scenarios.

Not surprisingly, these results suggest that the greatest amount of action (restoring all 19 geographic areas and implementing Phase III) has the greatest impact on steelhead and salmon productivity and abundance. However, the relative benefit of different actions varies among the species. For example, implementation of Phase III has a relatively small impact on steelhead, while restoring all 19 areas has a large impact. In contrast, implementing Phase III and restoring only the most important geographic area has a greater impact on spring Chinook than restoring all 19 areas and not implementing Phase III. A future challenge will be to examine the economic cost effectiveness, cultural, social, and political ramifications of each restoration scenario. However, the aquatic working group has adopted as adult abundance objectives those abundances found under restoration scenario 2, restoration of all priority areas and implementation of Phase III, and therefore efforts will be made to restore as many priority areas as possible and to support the development and implementation of Phase III (see Management Plan, Section 5).

The QHA model does not present quantitative measures of the benefits accrued from restoration. However, it does prioritize areas for restoration and protection and ranks limiting factors. Qualitative working hypotheses, based on the results of QHA, for bull trout and redband trout are presented below.

Bull Trout
Restoration of the top priority areas designed to address channel complexity, high water temperatures, and channel form will result in increases in bull trout abundance.

Redband Trout
Restoration of the top priority areas designed to address channel form, riparian condition, and fine sediment will result in increases in redband trout abundance.

The aquatic working group has developed a set of working hypotheses (and objectives and strategies) for each of the priority restoration areas. These hypotheses are outlined in the Management Plan, Section 5, and were not shown here for the sake of brevity.

3.6.1.2 Desired Future Conditions and Properly Functioning Conditions

The general desired future condition is to develop steelhead and salmon populations to levels that provide for tribal and sports harvest and enough spawning escapement to enhance natural production. This is in line with the vision for the subbasin (see Management Plan, Section 5) of supporting "sustainable resource-based activities that contribute to the social, cultural, and economic well-being of the communities within the subbasin." The restoration scenarios and objectives and strategies outlined in the Management Plan will move us towards this vision.

EDT provides an estimate of the abundances of steelhead and salmon under "properly functioning conditions" (PFC). PFC is a concept developed by the BLM and further refined for salmonids by NMFS to apply ratings of environmental attributes of systems given the current economic, political, and social constraints. An analysis of PFC for the Umatilla/Willow subbasin was conducted by Mobrand Biometrics and their report and results are given here.

Analysis of Properly Functioning Conditions in the Umatilla River
Mobrand Biometrics
May 18, 2004

Description of PFC Conditions in EDT

Properly functioning conditions (PFC) is a concept created originally by the Bureau of Land Management (BLM) to assess the natural habitat-forming processes of riparian and wetland areas (Pritchard and others 1993). When these processes are working properly, it can be assumed that environmental conditions are suitable to support productive populations of native anadromous and resident fish species. The notion of Properly Functioning Conditions for salmonid systems has also been advanced by the National Marine Fisheries Service (1996) in connection with recovery of species listed under the Endangered Species Act.

The PFC concept has been translated into a set of EDT Level 2 attribute ratings—ratings that define a PFC environmental condition relevant to anadromous salmonids within Pacific Northwest streams. Following an assessment of current and template conditions, EDT was used to assess population performance for a third condition, PFC. The PFC scenario is not necessarily advocated by any management agency and has not been analyzed for feasibility. Instead, it is used to illustrate species performance under a set of conditions likely to be conducive to healthy fish populations.

PFC does not imply pristine or template conditions. There are many examples of healthy populations occupying degraded habitat (Hanford Reach Chinook, for example). With this in mind, PFC ratings were applied to all reaches regardless of current habitat rating (e.g., if riparian function is 100% for the current condition, the PFC condition would still apply the 70% functional rating).

Also, PFC is not intended to imply a standard against which all streams are compared. PFC cannot be "better" than historic conditions for a stream reach (e.g., if percent fine sediment in historic reconstruction was 15%, the PFC rating for sediment must be greater than or equal to 15%).

We used Properly Functioning habitat conditions outlined by the National Marine Fisheries Service (1996) to help define the EDT PFC Level 2 rating. The NMFS document includes a Matrix of Pathways and Indicators (MPI) that relates closely to EDT attributes. An inter-agency team organized by Washington Department of Fish and Wildlife and the Northwest Indian Fisheries Commission was responsible for translating the NMFS definitions into EDT Level 2 attributes. EDT attribute ratings and their relationship to the NMFS definition of PFC are presented in Table 51. However, NMFS has not, at this time, endorsed the EDT PFC definition in connection with recovery of listed fish populations. The MPI addressed only a subset of the attributes used in EDT. All attributes used in EDT were assigned a PFC condition by the inter-agency team.

Table 51 also includes those attributes that were not defined by NMFS but were assigned a PFC rating by the technical team. Our guidance for these attributes was an understanding of the intent of the NMFS definition of properly functioning gleaned largely from attributes described in the MPI.

The composition of habitat types (pool, riffle, glide, etc) was not clearly defined in the MPI for PFC. The MPI provided pool frequency by channel width (number of pools per mile). However, this description did not adequately consider differences in gradient and channel confinement between stream reaches. Furthermore, the pristine composition of habitat types is not consistent with the overall PFC definition. Simply applying the template assumptions to PFC is not appropriate.

The EDT definition of habitat types under PFC assumes 80% of the template or 80% of current (whatever is greater) pool type habitat (primary pools, backwater pools and pool tailouts, and beaver ponds) within the reach. The composition of non-pool habitat (riffles and glides) is calculated, using the template composition of these habitat types for the reach. This assumes that the template characterization for riffle and glide habitat (largely based on an assessment of channel gradient and confinement for the reach) would correctly represent the natural composition (i.e., derived through natural habitat-forming processes) for these habitat types.

Table 51. Correspondence of Properly Functioning Condition as designated by NMFS (1996) and PFC as used in the EDT model.

Attribute	NMFS (1996) Properly Functioning	Representation of PFC in EDT Level 2 Environmental Attribute
Hydrologic Characteristics		
1) Annual Variation in High Flow	a) Change in Peak/Base Flow: Watershed hydrograph indicates peak flow, base flow, and flow timing characteristics comparable to an undisturbed watershed of similar size, geology, and geography	Consistent with undisturbed watershed of similar size, geology, and geography (Rating 2).
2) Annual Variation in Low Flow		Consistent with natural runoff pattern or hydro project following WDFW ramping rate criteria (Rating 2).
3) Diel Variation in Flow		Consistent with undisturbed watershed of similar size, geology, and geography (Rating 1).
4) Intra-Annual Variation in High Flow	b) Increase in Drainage Network: Zero or minimum increases in drainage network density due to roads.	Consistent with undisturbed watershed of similar size, geology, and geography (Rating 2).
5) Natural Hydrologic Regime	Not described	Attribute describes basic geomorphology and hydrology of basin
6) Regulated Hydrologic Regime	Not described	Flow not modified by hydro project (Rating 0)
Stream Corridor Structure		
7) Channel Length	Not described	EDT analysis assumed historic (template) channel length, gradient and widths; this assumption consistent with assumptions for channel hydromodifications (none)
8) Gradient		
9) Channel Minimum Width		
10) Channel Maximum Width		
11) Hydromodifications	Off-channel areas are frequently hydrologically linked to main channel; overbank flows occur and maintain wetland functions, riparian vegetation and succession	Stream channel is fully connected to the floodplain although very minor structures may exist that do not result in flow restriction or constriction (Rating 0).
12) Natural Channel Confinement	Not described; attribute describes basic geomorphology of reach	No difference historic and current ratings in EDT
13) Habitat Types	a) Pool Frequency: Width 5' 184 pools/mile Width 10' 96 pools/mile Width 15' 70 pools/mile Width 20' 56 pools/mile Width 50' 26 pools/mile Width 75' 23 pools/mile Width 100' 18 pools/mile b) Pool Quality: Pools > 1 meter depth (holding pools) with good cover and cool water, minor reduction of pool volume by fine sediment	Assumed to be consistent with 80% of historic (template) pool frequency; EDT criteria developed to acknowledge reach-specific differences in pool frequency.
14) Habitat Type – Off Channel	Backwaters with cover, and low-energy off-channel areas (ponds, oxbows, etc.)	Assumed full connection of historic (template) off-channel habitats.
15) Migration Obstructions	Any man-made barriers present in watershed allow upstream and downstream fish passage at all flows	Obstructions removed or designed to allow full passage of juveniles and adults (Rating 0)

Attribute	NMFS (1996) Properly Functioning	Representation of PFC in EDT Level 2 Environmental Attribute
16) Water withdrawals	Not described	Very minor withdrawals (entrainment probability considered to be very low)
17) Bed Scour	Although not described, bank stability - >90% of banks not actively eroding - implies a stable stream bed.	Average depth of scour >2 cm and < 10 cm (Rating 1)
18) Icing	Not described	Riparian function is high, assumed no degradation of channel stability due to icing – assume historic (template) condition
19) Riparian Function	The riparian reserve system provides adequate shade, large woody debris recruitment, and habitat protection and connectivity in all subwatersheds, and buffers include known refugia for sensitive aquatic species (>80% intact); and/or grazing impacts; percent similarity of riparian vegetation to the potential natural community composition > 50%.	> 70%-90% of functional attributes present (overbank flows, vegetated streambanks, groundwater interactions typically present) (modeled 70% - Rating 1.6).
20) Wood Debris	>80 pieces/mile (diameter > 2"; length > 50') and adequate sources of woody debris recruitment in riparian areas.	Complex array of large wood pieces but fewer cross channel bars and fewer pieces of sound large wood due to reduced recruitment; influences of large wood and jams are a prevalent influence on channel morphology where channel gradient and flow allow such influences. (Rating 1).
21) Embeddedness	Dominant substrate is cobble or gravel, or embeddedness < 20%	>10% and <25% covered by fine sediment (Rating 1)
22) Fine Sediment (< 0.85 mm) and Turbidity	Fines: < 12%, turbidity low	Fines: 6%-11% (modeled 11% fines - Rating 1.5). Turbidity low, infrequent episodes, short duration, low concentrations (<50 mg/l) (Rating 0.5)
Water Quality		
23) Alkalinity and Dissolved Oxygen	Not described	Assumed historic (template) conditions
24) Pollutants (Metals, misc. pollutants)	Low levels of chemical contamination from agricultural, industrial and other sources, no excess nutrients, no CWA 303d designated reaches	No toxicity expected due to dissolved heavy metals to salmonids under prolonged exposure (1 month exposure assumed) (Rating 0.5).
25) Nutrient enrichment		Very small amount suspected through land use activities (Rating 1.5)
26) Temperature – Daily Maximum	10-14 C	10-16 C on warmest day (Rating 1)
27) Temperature – Daily Minimum	Not described	Assumed historic (template) conditions
28) Temperature – Spatial Variation	Not described	Assumed historic (template) conditions

Attribute	NMFS (1996) Properly Functioning	Representation of PFC in EDT Level 2 Environmental Attribute
Biological Community		
28) Biological community (benthic community richness, introduced species, predator risk, and fish community richness)	Not Described	Assumed historic (template) conditions
29) Fish Pathogens	Not Described	a) No fish stocking within last decade; or b) no sockeye population in basin; or c) no viral epizootics in kokanee populations at the subbasin level (Rating 1).
30) Salmon Carcasses	Not Described	Very abundant -- an average number of carcasses per total miles of main channel habitat >400 and < 800 (Rating 1.5).
22) Hatchery Outplants	Not Described	No more than two instances of fish releases in the past decade in the drainage (Rating 1.5).

Application of PFC conditions to the Umatilla River

The PFC conditions in Table 157 were applied to the Umatilla River and analyzed with EDT for the four defined populations. As described above, PFC conditions are generally an improvement over current conditions but always less than the template condition. Application of the PFC restored a substantial portion of the estimated potential of the four populations in the Umatilla River. PFC produced 89 percent of the potential for summer steelhead (Figure 157), 70 percent of the potential for coho (Figure 158), 83 percent of the potential for spring Chinook (Figure 159) and 88 percent of the potential for fall Chinook (Figure 160). PFC produced a Diversity Index similar to the template except for coho for which PFC resulted in about 50 percent of the template Diversity Index.

Figure 157. Estimated potential of the Umatilla River for summer steelhead under three scenarios.

Umatilla Summer Steelhead

Scenario	Diversity index	Productivity	Abundance
Current without harvest	40%	5.0	2,815
PFC Scenario	98%	10.0	8,293
Reference potential	99%	14.3	9,317

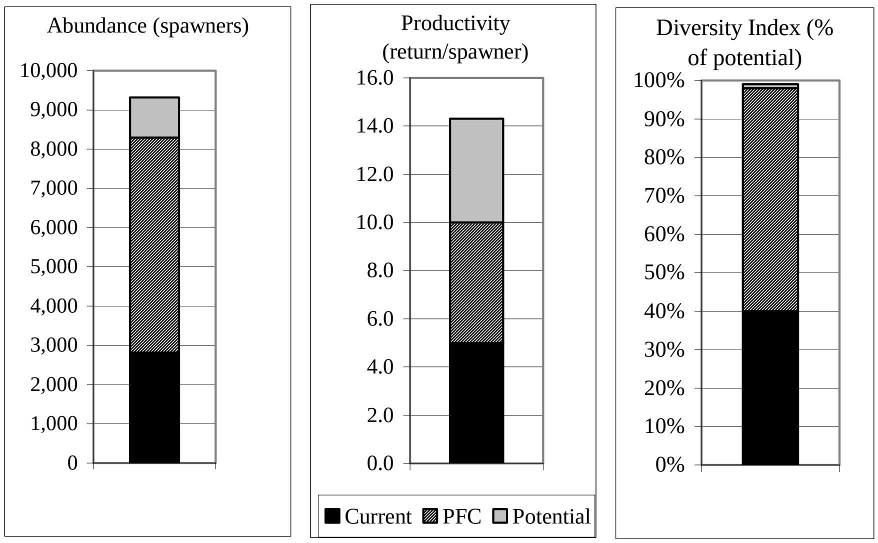

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Figure 158. Estimated potential of the Umatilla River for coho under three scenarios.

Umatilla Coho

Scenario	Diversity index	Productivity	Abundance
Current without harvest	14%	0.4	-
PFC Scenario	49%	2.5	3,136
Reference potential	97%	3.6	4,504

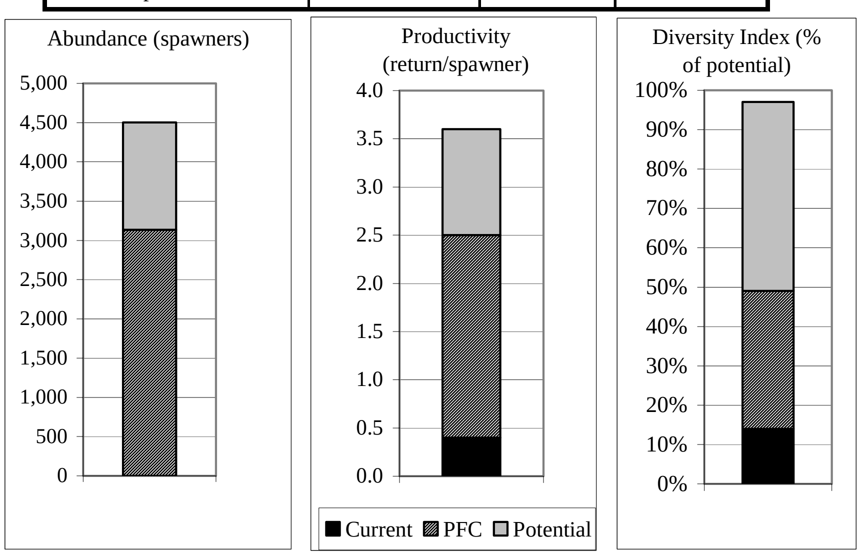

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Figure 159. Estimated potential of the Umatilla River for spring Chinook under three scenarios.

Umatilla Spring Chinook

Scenario	Diversity index	Productivity	Abundance
Current without harvest	32%	2.4	498
PFC Scenario	97%	9.0	4,126
Reference potential	100%	13.5	4,958

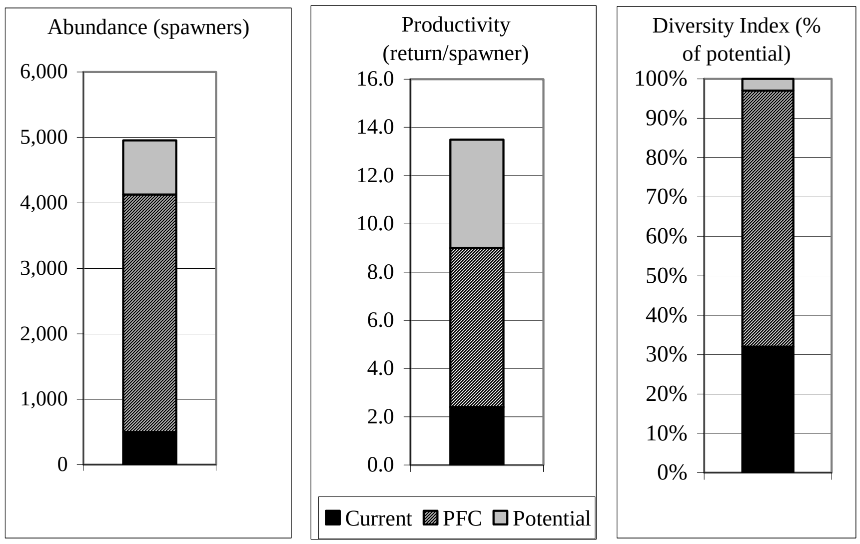

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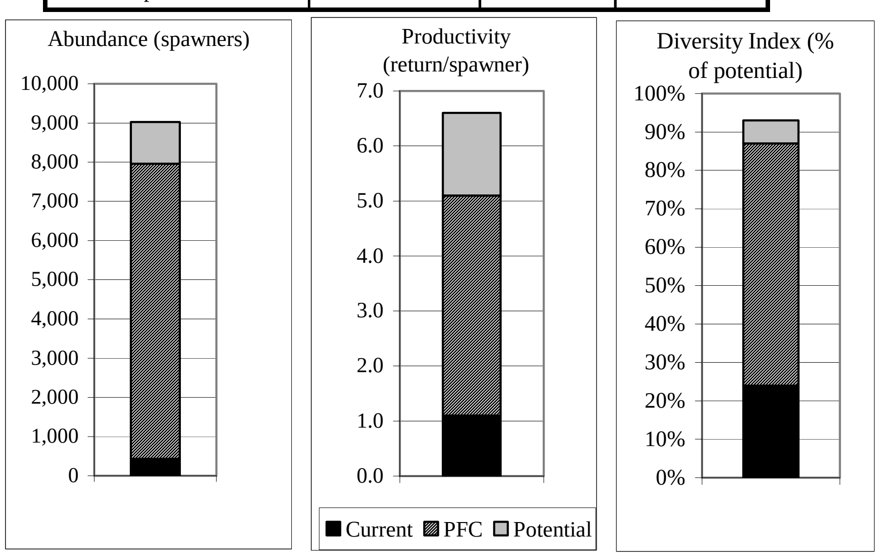
Figure 160. Estimated potential of the Umatilla River fall Chinook under three scenarios.

Umatilla Fall Chinook

Scenario	Diversity index	Productivity	Abundance
Current without harvest	24%	1.1	434
PFC Scenario	87%	5.1	7,960
Reference potential	93%	6.6	9,027



May 18, 2004

As can be seen from the analysis by Mobrand Biometrics, PFC conditions enhance the abundance and productivity of all anadromous focal species greatly, bringing them close to historic (i.e., "reference") values. While PFC does not represent current management goals (achieving PFC in all areas of the subbasin will be a tremendous and costly amount of work), it does provide an estimate of the current potential of the system and a very long-term, 75 year, goal.

3.6.2 Terrestrial Wildlife Synthesis and Interpretation

The terrestrial assessment was conducted using existing data on the Umatilla/Willow subbasin in combination with new products, such as IBIS, which were made available through the subbasin planning effort. The results from that assessment that are most relevant to the development of the management plan are synthesized and interpreted in this section. These results, organized by focal habitat type, include a summary of the focal species, habitat status, limiting factors, desired future conditions, working hypotheses, opportunities, and significant data gaps and uncertainties.

Several aspects of the terrestrial wildlife assessment differ from the aquatic assessment in notable ways. The term "limiting factor" is used more generally in the wildlife assessment than in the aquatic assessment. Limiting factors for wildlife are generally described in terms of activities or conditions that are believed to negatively impact wildlife primarily through their effect on habitat (e.g., timber harvest, the invasion of exotic vegetation). These activities or conditions are believed to impact focal and obligate wildlife species via a variety of mechanisms that affect key environmental correlates. In contrast, limiting factors for the aquatic assessment are often discussed in a more specific way (e.g., sedimentation, increased water temperature). Wildlife and aquatic assessments also differ with respect to the specificity of the desired future conditions and the working hypotheses. Desired future conditions for wildlife are framed in terms of having a sufficient amount of high quality habitat to support healthy populations of focal and obligate species, with high quality habitat defined with respect to key environmental correlates. However, wildlife managers cannot at this point quantitatively define how much high quality habitat is needed to support healthy, self-sustaining populations of wildlife species. In contrast, aquatic managers have much more detailed information about the 1) the status of certain aquatic focal species, 2) the relationship of environmental variables and population attributes of those focal species, and 3) a quantitative model (EDT) that can be used to quantify desired future conditions. Likewise, the EDT used in the aquatic assessment allows for working hypotheses to relate strategies to specific quantitative population responses in focal species. Wildlife working hypotheses are not as quantitative; although they assume that addressing limiting factors through management strategies will positively influence focal species populations, they cannot predict the magnitude or mechanism of that response. This limitation results from insufficient information about focal wildlife species and the lack of a quantitative model (such as EDT) for terrestrial wildlife.

Finally, although opportunities are described for each habitat below, there exists a general opportunity to protect and enhance wildlife habitat and populations that applies to all habitat types. As described in Section 3.1, a large portion of the subbasin's economy is related to agriculture, which is often pitted against fish and wildlife interests in other areas. The Umatilla/Willow subbasin is unique in that agricultural, tribal, and governmental groups, as well as other stakeholders, have worked together to form mutually acceptable solutions to fisheries and wildlife problems in the past. This past history of success is an opportunity in the sense that it has developed a foundation of trust and cooperation that can be capitalized on in the future. Thus, subbasin planners are committed to continuing with this cooperative model as they develop and implement terrestrial wildlife objectives and strategies.

The synthesis and interpretation for each habitat that follows is based on previous sections. Information on focal species can be found in Section 3.2.4.1, data on habitat status, limiting factors, and protection opportunities can be found in Sections 3.2.4.2 and 3.5.2, and information on key environmental correlates can be found in Section 3.4.2. For the sake of brevity, primary literature citations and data sources that are cited in these past sections are not repeated in this section.

MIXED CONIFER FOREST

Focal Species: Pileated Woodpecker

Habitat Status: As indicated in Table 52, the area of mixed conifer forest in the Umatilla/Willow subbasin has apparently doubled since historic times (c. 1850). However, planners believe that the quality of this habitat has declined, although no quantitative data on habitat quality (e.g., structure, species or seral diversity) of historic or current mixed conifer forest of the subbasin are available through assessment databases, such as IBIS.

Table 52. Estimated acreages of historic and current mixed conifer habitat in the Umatilla/Willow subbasin.

Historic Acreage (Historic Percent)	Current Acreage (Current Percent)	Change in Acreage (Percent Change)
83,522 acres (3%)	167,299 acres (6%)	+83,777 acres (+100%)

Limiting Factors: The quality of mixed conifer forest in the Umatilla/Willow subbasin is believed to have declined due to timber harvest, altered fire regimes, ponderosa pine encroachment, development, outbreaks of western spruce budworm and Douglas-fir tussock moth, and exotic plant invasion (see Section 3.5.2 for more description). These factors have resulted in direct loss of old growth habitat and fragmentation and degradation of remaining mixed conifer forest. Loss of old growth habitat has occurred primarily because of timber harvesting, while habitat degradation is primarily associated with altered fire regimes. Fire suppression has promoted less fire-resistant, shade-tolerant trees, and led to mixed conifer forests with low snag density, high tree density, and stands dominated by smaller and more shade-tolerant trees.

Desired Future Conditions: The desired future condition of mixed conifer forest in the Umatilla/Willow subbasin is to have a sufficient amount of high quality habitat to support healthy populations of Pileated Woodpecker and other mixed conifer obligates. High quality habitat for these species is currently understood to be habitat with the following key environmental correlates:

- complex multi-layered closed canopies with a major component of large trees (>90 feet in height) and a high basal area
- mature seed producing trees
- numerous uneven-aged individual trees and an understory of smaller woody plants with emphasis on multi-conifer species composition including lodgepole pine, Douglas fir, Western larch, Engelmann spruce, subalpine fir, and white pine
- dead and dying trees 39 – 69 feet tall, 100-300 years old, and > 20 inches dbh
- dead and decaying wood, with an abundance of insects
- a minimum forest parcel size of 2,000 acres

Working Hypothesis: The key assumptions that make up the working hypothesis for mixed conifer forest are:

1. Wildlife species associated with mixed conifer forest are primarily limited by the availability of suitable habitat in the Umatilla/Willow subbasin.
2. Suitable habitat for the Pileated Woodpecker and other obligate species can be described by certain environmental conditions (i.e., the key environmental correlates described above).
3. The limiting factors described above negatively impact these wildlife species through their effect on the quality of mixed conifer habitat.
4. Management strategies that address these limiting factors will benefit wildlife species associated with mixed conifer by increasing the availability of suitable habitat.

Opportunities: The opportunities for improving mixed conifer habitat in ways that benefit the Pileated Woodpecker and other obligate mixed conifer species are primarily dictated by current ownership and protection. As seen in Tables 53 and 54, most (>90%) of the mixed conifer habitat in Umatilla/Willow subbasin is under no or low protected status and most (67%) is federally owned. Thus, these opportunities suggest that strategies aimed at increasing protection and enhancement by working with federal agencies should be emphasized.

Table 53. Estimated protected status of mixed conifer forest in the Umatilla/Willow subbasin.

High Protection	Medium Protection	Low Protection	No Protection
12,788 acres (8%)	543 acres (<1%)	98,825 acres (59%)	55,143 acres (33%)

Table 54. Estimated ownership of mixed conifer forest in the Umatilla/Willow subbasin.

Federal Lands	Native American Lands	State Lands	NGO Lands	Private Lands
111,535 acres (67%)	11,661 acres (7%)	1,039 acres (<1%)	0 acres (0%)	43,065 acres (26%)

Significant Data Gaps and Uncertainties: Several significant data gaps and uncertainties exist for mixed conifer habitat and its associated wildlife in the Umatilla/Willow subbasin. To fill these gaps, the following actions are needed:

- Obtain data on the quality of mixed conifer habitat in the Umatilla/Willow subbasin, including data on structural state, seral stage, and ecological function as related to the Pileated Woodpecker and other obligate species. Use these data to refine existing information on habitat suitability for the Pileated Woodpecker (see Section 3.2.4.1).
- Refine and field-truth data on the location, size, spatial distribution, ownership, and protected status of mixed conifer in the subbasin.
- Identify areas in the subbasin that could be converted to mixed conifer habitat to enlarge habitat patches, provide new reservoir habitat, or enhance connectivity between two or more extant patches.
- Generate population and distribution data for the Pileated Woodpecker and other species associated with mixed conifer in the Umatilla/Willow subbasin.
- Determine the amount of high quality mixed conifer habitat needed to support viable populations of the Pileated Woodpecker in the subbasin.

PONDEROSA PINE FOREST

Focal Species: White-headed Woodpecker

Habitat Status: As indicated in Table 55, the area of ponderosa pine forest in the Umatilla/Willow subbasin has apparently increased by over 10% since historic times (c. 1850). However, planners believe that the quality of this habitat has declined, although no quantitative data on habitat quality (e.g., structure, species or seral diversity) of historic or current ponderosa pine forest of the subbasin are available through assessment databases, such as IBIS.

Table 55. Estimated acreages of historic and current ponderosa pine habitat in the Umatilla/Willow subbasin.

Historic Acreage (Historic Percent)	Current Acreage (Current Percent)	Change in Acreage (Percent Change)
143,321 acres (5%)	162,257 acres (6%)	+18,936 acres (+13%)

Limiting Factors: The quality of ponderosa pine forest habitat is believed to have declined due to mixed forest encroachment, altered fire regimes and stand-replacing fires, timber harvest, exotic plant invasion, outbreaks of western spruce budworm and Douglas-fir tussock moth, livestock grazing, development, and recreational activities (see Section 3.5.2 for more description). Two of the major factors responsible for habitat loss and degradation of functional ponderosa pine forest are harvest of late and old structure pine and the encroachment of Douglas-fir and grand fir into ponderosa pine dominated habitats. The encroachment is due primarily to fire suppression and intense, stand-replacing wildfires; the latter results from high fuel loads associated with increases in brushy species and the establishment of ladder fuels from encroaching shade tolerant understory trees.

Desired Future Conditions: The desired future condition of ponderosa pine forest in the Umatilla/Willow subbasin is to have a sufficient amount of high quality habitat to support healthy populations of White-headed Woodpecker and other ponderosa pine obligates. High quality habitat for these species is currently understood to be habitat with the following key environmental correlates:

- large patches (> 800 acres) of open mature/old growth-dominated ponderosa pine
- canopy closures between 30-50%
- 2.5 snags per acre, with each snag > 24 inches dbh
- sparse understory vegetation

Working Hypothesis: The key assumptions that make up the working hypothesis for ponderosa pine forest are:

1. Wildlife species associated with ponderosa pine forest are primarily limited by the availability of suitable habitat in the Umatilla/Willow subbasin.
2. Suitable habitat for the White-headed Woodpecker and other obligate species can be described by certain environmental conditions (i.e., the key environmental correlates described above).
3. The limiting factors described above negatively impact these wildlife species through their effect on the quality of ponderosa pine habitat.
4. Management strategies that address these limiting factors will benefit wildlife species associated with ponderosa pine by increasing the availability of suitable habitat.

Opportunities: The opportunities for improving ponderosa pine habitat in ways that benefit the White-headed Woodpecker and other obligate ponderosa pine species are primarily dictated by current ownership and protection. As seen in Tables 56 and 57, most (98%) of the ponderosa pine habitat in Umatilla/Willow subbasin is under no or low protected status and most (61%) is privately owned. Thus, these opportunities suggest that strategies aimed at increasing protection and enhancement by working with landowners should be emphasized.

Table 56. Estimated protected status of ponderosa pine forest in the Umatilla/Willow subbasin.

High Protection	Medium Protection	Low Protection	No Protection
3,504 acres (2%)	135 acres (<1%)	43,058 acres (27%)	115,559 acres (71%)

Table 57. Estimated ownership of ponderosa pine forest in the Umatilla/Willow subbasin.

Federal Lands	Native American Lands	State Lands	NGO Lands	Private Lands
45,648 (28%)	16,425 acres (10%)	825 acres (<1%)	0 acres (0%)	99,359 acres (61%)

Significant Data Gaps and Uncertainties: Several significant data gaps and uncertainties exist for ponderosa pine habitat and its associated wildlife in the Umatilla/Willow subbasin. To fill these gaps, the following actions are needed:

- Obtain data on the quality of ponderosa pine habitat in the Umatilla/Willow subbasin, including data on structural state, seral stage, and ecological function as related to the White-headed Woodpecker and other obligate species. Use these data to improve existing information on habitat suitability for the White-headed Woodpecker (see Section 3.2.4.1).
- Refine and field-truth data on the location, size, spatial distribution, ownership, and protected status of ponderosa pine.
- Identify areas that could be converted to ponderosa pine habitat to enlarge habitat patches, provide new reservoir habitat, or enhance connectivity between two or more extant patches.
- Generate population and distribution data for the White-headed Woodpecker and other species associated with ponderosa pine.
- Determine the amount of high quality ponderosa pine habitat needed to support viable populations of the White-headed Woodpecker in the subbasin.

QUAKING ASPEN FOREST

Focal Species: Red-naped Sapsucker

Habitat Status: As indicated in Table 58, an estimated 94% of quaking aspen forest in the Umatilla/Willow subbasin has been lost since historic times (c. 1850). In addition, although no quantitative data on habitat quality of historic or current quaking aspen forest of the subbasin are available through assessment databases, such as IBIS, subbasin planners believe that much of the remaining habitat is degraded.

Table 58. Estimated acreages of historic and current quaking aspen habitat in the Umatilla/Willow subbasin.

Historic Acreage (Historic Percent)	Current Acreage (Current Percent)	Change in Acreage (Percent Change)
1,236 acres (<1%)	78 acres (<1%)	-1,158 acres (-94%)

Limiting Factors: The major factors affecting aspen habitat in the Umatilla/Willow subbasin are intensive grazing by livestock and native ungulates, fire suppression, and the invasion of coniferous species.

Desired Future Conditions: The desired future condition of quaking aspen forest in the Umatilla/Willow subbasin is to have a sufficient amount of high quality habitat to support healthy populations of Red-naped Sapsucker and other quaking aspen obligates. High quality habitat for these species is currently understood to be habitat with the following key environmental correlates:

- > 1.5 snags per acre
- trees > 39 feet in height and > 10 inch dbh
- patch size > 10 acres
- an abundance of trees with shelf fungus

Working Hypothesis: The key assumptions that make up the working hypothesis for quaking aspen forest are:

1. Wildlife species associated with quaking aspen forest are primarily limited by the availability of suitable habitat in the Umatilla/Willow subbasin.
2. Suitable habitat for the Red-naped Sapsucker and other obligate species can be described by certain environmental conditions (i.e., the key environmental correlates described above).
3. The limiting factors described above negatively impact these wildlife species through their effect on the quality of quaking aspen habitat.
4. Management strategies that address these limiting factors will benefit wildlife species associated with quaking aspen by increasing the availability of suitable habitat.

Opportunities: The opportunities for improving quaking aspen habitat in ways that benefit the Red-naped Sapsucker and other obligate quaking aspen species are primarily dictated by current ownership and protection. Although no data are available from IBIS on the ownership or protected status of the limited amount of quaking aspen habitat in the subbasin, subbasin planners believe that most of it is on CTUIR or federal lands with an uncertain protected status. Thus, these opportunities suggest that strategies aimed at increasing protection and enhancement by working with federal and tribal agencies should be emphasized.

Significant Data Gaps and Uncertainties:
Several significant data gaps and uncertainties exist for quaking aspen habitat and its associated wildlife in the Umatilla/Willow subbasin. To fill these gaps, the following actions are needed:

- Gather comprehensive data on the location, size, spatial distribution, ownership, and protected status of quaking aspen in the subbasin.
- Obtain data on the quality of quaking aspen habitat in the Umatilla/Willow subbasin, including data on ecological function as related to the Red-naped Sapsucker and other obligate species. Use these data to improve existing information on habitat suitability for the Red-naped Sapsucker (see Section 3.2.4.1).
- Identify areas in the subbasin that could be converted to quaking aspen habitat to enlarge habitat remnants, provide new reservoir habitat, or enhance connectivity between two or more extant remnants.

- Generate population and distribution data for the Red-naped Sapsucker and other species associated with quaking aspen.
- Determine the amount of high quality quaking aspen habitat needed to support viable populations of the Red-naped Sapsucker in the subbasin.

WESTERN JUNIPER WOODLAND

Focal Species: Ferruginous Hawk

Habitat Status: As indicated in Table 59, the area of western juniper woodland habitat in the Umatilla/Willow subbasin is estimated to have increased by over 1,000% since historic times (c. 1850). However, planners believe the current acreage is overestimated. As described in Section 3.2.4.2, juniper woodlands are found in two general areas of the subbasin: 1) on the foothills of the Blue Mountains in a mid-elevation transitional zone between ponderosa pine and grasslands/shrub-steppe habitats, and 2) as isolated trees or patches at lower elevations in shrub-steppe habitat. Unlike neighboring subbasins, such as the John Day subbasin, the invasion of juniper found in transitional zones into grasslands of the Umatilla/Willow subbasin is not a serious problem. Although the current distribution of mid-elevation transitional zone juniper woodland in the Umatilla/Willow subbasin compared to historic conditions is unclear (see Section 3.2.4.2), it has probably increased slightly or remained relatively constant. In contrast, juniper habitat associated with grassland and shrub-steppe is believed have decreased by 50-65% since historic times. Regardless of the amount currently in existence in the subbasin, subbasin planners believe the quality of this habitat has declined, although no quantitative data on habitat quality of historic or current western juniper in the subbasin are available through assessment databases, such as IBIS.

Table 59. Estimated acreages of historic and current western juniper habitat in the Umatilla/Willow subbasin.

Historic Acreage (Historic Percent)	Current Acreage (Current Percent)	Change in Acreage (Percent Change)
2,741 acres (<1%)	36,795 acres (1%)	+34,054 acres (+1,377)

Limiting Factors: The most important limiting factors of juniper woodlands, especially of mature trees or stands associated with shrub-steppe or grasslands, are agricultural conversion, altered fire regimes, overgrazing, and exotic plant invasions.

Desired Future Conditions: The desired future condition of western juniper woodland in the Umatilla/Willow subbasin is to have a sufficient amount of high quality habitat to support healthy populations of Ferruginous Hawk, its prey, and other western juniper obligates. High quality habitat for these species is currently understood to be habitat with the following key environmental correlates:

- isolated, mature juniper trees with a density > one per square mile

- native perennial grasses and other low shrub cover between 6-24 inches to support ground squirrels and jackrabbits, which are major prey of Ferruginous Hawks
- mature, short (< 33 ft. in height) juniper for Ferruginous Hawk nesting trees

Working Hypothesis: The key assumptions that make up the working hypothesis for western juniper woodlands are:

1. Wildlife species associated with western juniper woodlands are primarily limited by the availability of suitable habitat in the Umatilla/Willow subbasin.
2. Suitable habitat for the Ferruginous Hawk, its prey, and other obligate species can be described by certain environmental conditions (i.e., the key environmental correlates described above).
3. The limiting factors described above negatively impact these wildlife species through their effect on the quality of western juniper habitat.
4. Management strategies that address these limiting factors will benefit wildlife species associated with western juniper by increasing the availability of suitable habitat.

Opportunities: The opportunities for improving western juniper habitat in ways that benefit the Ferruginous Hawk and other obligate western juniper species are primarily dictated by current ownership and protection. As seen in Tables 60 and 61, virtually all of the western juniper habitat in Umatilla/Willow subbasin is under no or low protected status and most (99%) is privately owned. Thus, these opportunities suggest that strategies aimed at increasing protection and enhancement by working with landowners should be emphasized.

Table 60. Estimated protected status of western juniper woodland in the Umatilla/Willow subbasin.

High Protection	Medium Protection	Low Protection	No Protection
0 acres (0%)	18 acres (<1%)	525 acres (1%)	35,952 acres (99%)

Table 61. Estimated ownership of western juniper woodland in the Umatilla/Willow subbasin.

Federal Lands	Native American Lands	State Lands	NGO Lands	Private Lands
525 (1%)	0 acres (0%)	18 acres (<1%)	0 acres (0%)	35,952 acres (99%)

Significant Data Gaps and Uncertainties: Several significant data gaps and uncertainties exist for western juniper habitat and its associated wildlife in the Umatilla/Willow subbasin. To fill these gaps, the following actions are needed:

- Gather comprehensive data on the location, size, spatial distribution, ownership, and protected status of western juniper in the subbasin.
- Obtain data on the quality of western juniper habitat in the Umatilla/Willow subbasin, including data on its ecological function as related to the Ferruginous Hawk and its

prey and other obligate species. Use these data to refine existing information on habitat suitability for Ferruginous Hawk (see Section 3.2.4.1).
- Identify areas that could be converted to western juniper habitat to enlarge habitat remnants, provide new reservoir habitat, or enhance connectivity between two or more extant remnants.
- Generate population and distribution data for the Ferruginous Hawk, it prey, and other species associated with western juniper.
- Determine the amount of high quality western juniper habitat needed to support viable populations of the Ferruginous Hawk in the subbasin.

SHRUB-STEPPE

Focal Species: Sage Sparrow

Habitat Status: Shrub-steppe habitat in the Umatilla/Willow subbasin is found both at low-elevations, where it occurs primarily on silt and sand loam soils of the lower subbasin, and at higher-elevations, where it is primarily associated with the foothills of the Blue Mountains. As indicated in Section 3.2.4.2, the estimate produced by IBIS for current shrub-steppe habitat acreage in the Umatilla/Willow subbasin is believed to be inaccurate, so information from an alternative source (Kagan et al. 2000) was used to estimate historic and current acreages of low elevation shrub-steppe (see Section 3.2.4.2 for more details). Acreage estimates shown in Table 62 suggest that significant losses of both big sagebrush steppe and bitterbrush habitat have occurred in the subbasin. The amount of higher-elevation shrub-steppe (rigid sage/sandberg bluegrass shrub-steppe) is believed not to have changed significantly since historic times, and is currently estimated to be approximately 124,480 acres. The quality of both low and higher elevation shrub-steppe habitats is believed to have declined, although no quantitative data on habitat quality of historic or current shrub-steppe habitat of the subbasin are available.

Table 62. Estimated area (in acres) of historic (c. 1850) and current shrub-steppe habitat in the Umatilla/Willow subbasin.

Type of Shrub-Steppe	Historic Acreage	Current Acreage	Change in Acreage
Low Elevation Shrub-Steppe			
Big Sage/Bluebunch Wheatgrass	*	28,481	*
Big Sagebrush Steppe	302,951	43,085	-259,866 acres (-86%)
Bitterbrush	97,137	43,463	-53,674 acres (-55%)

* Not available

Limiting Factors: Major factors affecting both low and higher elevation shrub-steppe habitat in the Umatilla/Willow subbasin are agricultural conversion (including the conversion of CRP lands back into croplands), exotic plant invasion, alteration of fire regimes, purposeful seeding of non-native grasses, and livestock grazing (see Section 3.6.2). These factors result in habitat loss, fragmentation, and degradation. Historically, the single largest factor responsible for shrub-steppe habitat loss in the Umatilla/Willow subbasin is conversion to agriculture. Remaining shrub-steppe habitat continues to be threatened by agricultural conversion, but of even greater concern is the proliferation of exotic weeds. Cheatgrass is especially problematic, as described in Section 3.1.1.9, because it increases the frequency and severity of range fires, which can lead to the replacement of sagebrush, bitterbrush, and other native shrubs with cheatgrass. The invasion of exotic plants is facilitated by the loss of cryptogamic crusts resulting from soil disturbances associated with tillage and inappropriate livestock grazing practices. Non-native animal species, including nest competitors (e.g., European Starlings, House Sparrow), nest parasites (e.g., Brown Headed Cowbirds), and domestic predators (e.g., cats, dogs) also negatively affect obligate species in this habitat. The effects of non-native species are magnified by habitat fragmentation. Additionally, shrub-steppe habitats in proximity to agricultural, recreational, and residential areas may be subject to high levels of human disturbance.

Desired Future Conditions: Characterizing very specific critical environmental correlates that apply to all shrub-steppe habitat is difficult because shrub-steppe habitats are highly variable with respect to structure and plant species composition, both of which are strongly influenced by site conditions (e.g., hydrology, soil, topography). However, general ranges of critical environmental correlates that support the Sage Sparrow and most other obligate shrub species (e.g., Loggerhead Shrike, Burrowing Owl, Sage Thrasher) are as follows:

- late seral big sagebrush or bitterbrush with patches of tall shrubs with a height > 3 feet.
- mean sagebrush cover of 5-30%
- mean native herbaceous cover of 10-20% with <10% cover of non-native annual grass (e.g., cheatgrass) or forbs
- mean open ground cover, including bare ground and cryptogamic crusts > 20%
- mean native forb cover > 10%

Working Hypothesis: The key assumptions that make up the working hypothesis for shrub-steppe habitat are:

1. Wildlife species associated with shrub-steppe habitat are primarily limited by the availability of suitable habitat in the Umatilla/Willow subbasin.
2. Suitable habitat for the Sage Sparrow and other obligate species can be described by certain environmental conditions (i.e., the key environmental correlates described above).
3. The limiting factors described above negatively impact these wildlife species through their effect on the quality of shrub-steppe habitat.
4. Management strategies that address these limiting factors will benefit wildlife species associated with shrub-steppe by increasing the availability of suitable habitat.

Opportunities: Opportunities for protecting and enhancing shrub-steppe habitat differ from other habitats in the Umatilla/Willow subbasin because five areas (Horn Butte-Willow Creek, Boardman Bombing Range, Boeing Lease Lands, the Umatilla Army Depot, and Juniper Canyon; see Section 3.2.4.2 for description) contain not only a large portion of the existing low-elevation shrub-steppe habitat in the subbasin (up to 50%), but also the largest and highest quality remnants of low-elevation shrub-steppe. These areas are also significant because many of them have large portions of land that are owned or controlled by the federal government and TNC, which explains to some extent the patterns of ownership and protection status in low-elevation shrub-steppe evident in Tables 63 and 64. These five areas represent an excellent opportunity to protect and enhance some of the best existing low-elevation shrub-steppe in the Umatilla/Willow subbasin through cooperation with the federal government, TNC, and private landowners.

In contrast, the estimated 124,480 acres of higher-elevation shrub-steppe (primarily rigid sage/sandberg bluegrass) are generally dispersed in small fragments, primarily on private land, and with little to no protection (Tables 63 and 64). Opportunities for protection and enhancement of this habitat are best taken advantage of by strategies that emphasize cooperative actions with private landowners.

Table 63. Estimated area (in acres) of shrub-steppe habitat in the Umatilla/Willow subbasin in four levels of protected status.

Type of Shrub-Steppe	High Protection	Medium Protection	Low Protection	No Protection
Low Elevation Shrub-Steppe				
Big Sage/Bluebunch Wheatgrass	49 (<1%)	124 (<1%)	9,200 (32%)	19,109 (67%)
Big Sagebrush Steppe	59 (<1%)	294 (<1%)	9,234 (21%)	33,499 (78%)
Bitterbrush	2,535 (6%)	8,609 (20%)	8,638 (20%)	23,670 (54%)
Higher Elevation Shrub-Steppe				
Rigid Sage/Sandberg Bluegrass	0 (0%)	5,468 (4%)	16,904 (14%)	102,467 (82%)

Table 64. Estimated area (in acres) of shrub-steppe habitat in the Umatilla/Willow subbasin in five categories of ownership. Ownership of big sage/bluebunch wheatgrass is not known.

Type of Shrub-Steppe	Federal Lands	State Lands	Native American Lands	NGO Lands	Private Lands
Low Elevation Shrub-Steppe					
Big Sagebrush Steppe	2,899 (7%)	272 (<1%)	57 (<1%)	6,733 (16%)	33,231 (77%)
Bitterbrush	13,751 (31%)	1,117 (3%)	0 (0%)	5,555 (13%)	23,529 (53%)
Higher Elevation Shrub-Steppe					
Rigid Sage/Sandberg Bluegrass	22,370 (18%)	502 (<1%)	25 (<1%)	0 (0%)	101,940 (82%)

Significant Data Gaps and Uncertainties: Several significant data gaps and uncertainties exist for shrub-steppe habitat and its associated wildlife in the Umatilla/Willow subbasin. To fill these gaps, the following actions are needed:

- Obtain data on the quality of shrub-steppe habitat in the Umatilla/Willow subbasin, including data on ecological function as related to the Sage Sparrow and other obligate species. Use these data to improve existing information on habitat suitability for the Sage Sparrow (see Section 3.2.4.1).
- Reconcile differences between IBIS and other data with regard to the total acreage and distribution of shrub-steppe habitat in the subbasin, and refine and field-truth data on ownership and protected status of shrub-steppe in the subbasin.
- Identify areas in the subbasin that could be converted to shrub-steppe habitat to enlarge habitat remnants, provide new reservoir habitat, or enhance connectivity between two or more extant remnants.
- Generate population and distribution data for the Sage Sparrow and other species associated with shrub-steppe in the Umatilla/Willow subbasin.
- Determine the amount of high quality shrub-steppe habitat needed to support viable populations of the Sage Sparrow in the subbasin.

INTERIOR GRASSLANDS

Focal Species: Grasshopper Sparrow

Habitat Status: As indicated in Table 65, interior grasslands in the Umatilla/Willow subbasin are estimated to have declined by 74% since historic times (c. 1850). In addition, subbasin planners believe that the quality of remaining grassland habitat has also decreased, although no quantitative data on habitat quality of historic or current interior grasslands of the subbasin are available through assessment databases, such as IBIS.

Table 65. Estimated acreages of historic and current interior grassland habitat in the Umatilla/Willow subbasin.

Historic Acreage (Historic Percent)	Current Acreage (Current Percent)	Change in Acreage (Percent Change)
2,030,959 acres (78%)	528,269 acres (20%)	-1,502,690 acres (-74%)

Limiting Factors: As indicated in Section 3.5.2, major factors affecting grassland habitat in the Umatilla/Willow subbasin are agricultural conversion (including the conversion of CRP back into cropland), exotic weed invasion, purposeful seeding of non-native grasses, overgrazing, and human-altered fire regimes. These factors result in direct habitat loss, fragmentation, and degradation. The single largest factor in habitat loss is conversion to agriculture. The largest factor in habitat degradation is the proliferation of annual grasses and exotic weeds, such as cheatgrass and yellow starthistle, which either replace or radically alter native bunchgrass communities. This invasion of exotic plants is facilitated by the loss of cryptogamic crusts, resulting from soil disturbances associated with tillage and livestock grazing. Non-native animal species, including nest competitors (e.g., European Starlings, House Sparrow), nest parasites (e.g., Brown Headed Cowbirds), and domestic predators (e.g., cats, dogs) also impact native species productivity. The effects of non-native species are magnified by habitat fragmentation. Additionally, grassland habitats in proximity to agricultural and recreational areas may be subject to high levels of human disturbance.

Desired Future Conditions: The desired future condition of interior grasslands in the Umatilla/Willow subbasin is to have a sufficient amount of high quality habitat to support healthy populations of Grasshopper Sparrow and other grassland obligates. High quality habitat for these species is currently understood to be habitat with the following key environmental correlates:

For Native Grasslands

- native bunchgrass cover > 15% and comprising > 60% of total grassland cover
- tall bunchgrass (> 10 inches tall)
- native shrub cover < 10%

For Non-Native and Agricultural Grasslands (e.g. CRP lands)

- grass forb cover > 90%
- shrub cover < 10%
- variable grass heights (6-18 inches)

Landscape Level

- patch size > 100 acres or multiple small patches greater than 20 acres, within a mosaic of suitable grassland conditions

Working Hypothesis: The key assumptions that make up the working hypothesis for interior grasslands are:

1. Wildlife species associated with interior grasslands are primarily limited by the availability of suitable habitat in the Umatilla/Willow subbasin.
2. Suitable habitat for the Grasshopper Sparrow and other obligate species can be described by certain environmental conditions (i.e., the key environmental correlates described above).
3. The limiting factors described above negatively impact these wildlife species through their effect on the quality of grassland habitat.
4. Management strategies that address these limiting factors will benefit wildlife species associated with grasslands by increasing the availability of suitable habitat.

Opportunities: The opportunities for improving grassland habitat in ways that benefit the Grasshopper Sparrow and other obligate grassland species are primarily dictated by current ownership and protection. As seen in Tables 66 and 67, the vast majority (99%) of grassland habitat in the Umatilla/Willow subbasin is under no or low protected status and most (82%) is privately owned. Thus, these opportunities suggest that strategies aimed at increasing protection and enhancement by working with landowners should be emphasized.

Table 66. Estimated protected status of interior grasslands in the Umatilla/Willow subbasin.

High Protection	Medium Protection	Low Protection	No Protection
3,964 acres (<1%)	0 acres (0%)	37,603 acres (7%)	486,702 acres (92%)

Table 67. Estimated ownership of interior grasslands in the Umatilla/Willow subbasin.

Federal Lands	Native American Lands	State Lands	NGO Lands	Private Lands
41,224 acres (8%)	54,430 acres (10%)	225 acres (<1%)	0 acres (0%)	432,390 acres (82%)

Significant Data Gaps and Uncertainties: Several significant data gaps and uncertainties exist for grassland habitat and its associated wildlife in the Umatilla/Willow subbasin. To fill these gaps, the following actions are needed:

- Obtain data on the quality of grassland habitat in the Umatilla/Willow subbasin, including data on ecological function as related to the Grasshopper Sparrow and other obligate species. Use these data to refine existing information on habitat suitability for the Grasshopper Sparrow (see Section 3.4.2).
- Refine and field-truth data on the location, size, spatial distribution, ownership, and protected status of grassland in the subbasin.
- Identify areas in the subbasin that could be converted to grassland habitat to enlarge habitat patches, provide new reservoir habitat, or enhance connectivity between two or more extant patches.
- Generate population and distribution data for the Grasshopper Sparrow and other species associated with grassland in the Umatilla/Willow subbasin.
- Determine the amount of high quality grassland habitat needed to support viable populations of the Grasshopper Sparrow in the subbasin.

HERBACEOUS WETLANDS

Focal Species: Columbia spotted frog

Habitat Status: As indicated in Table 68, the area of herbaceous wetland habitat in the Umatilla/Willow subbasin is estimated to have declined by 75% since historic times (c. 1850). In addition, planners believe that the quality of remaining herbaceous wetlands has deteriorated, although no quantitative data on habitat quality of historic or current herbaceous wetland habitat of the subbasin are available through assessment databases, such as IBIS.

Table 68. Estimated acreages of historic and current herbaceous wetland habitat in the Umatilla/Willow subbasin.

Historic Acreage (Historic Percent)	Current Acreage (Current Percent)	Change in Acreage (Percent Change)
18,286 acres (<1%)	4,670 acres (<1%)	-13,616 acres (-75%)

Limiting Factors: Major factors that have led to the destruction and degradation of herbaceous wetlands in the Umatilla/Willow subbasin are habitat conversion and draining, lowering of ground water level, separation of floodplain from the stream channel due to dikes and levees, exotic plant and animal invasions, and livestock grazing.

Desired Future Conditions: The desired future condition of herbaceous wetland habitat in the Umatilla/Willow subbasin is to have a sufficient amount of high quality habitat to support healthy populations of Columbia spotted frog and other herbaceous wetland obligates. High quality habitat for these species is currently understood to be habitat with the following key environmental correlates:

- Abundant aquatic vegetation dominated by herbaceous species such as grasses, sedges, rushes. and emergent vegetation
- Clear, slow-moving or ponded perennial surface waters
- Relatively exposed, shallow-water (< 24 inches)
- Deep silt or muck substrate
- Small mammal burrows
- Undercut banks and spring heads

Working Hypothesis: The key assumptions that make up the working hypothesis for herbaceous wetland habitat are:

1. Wildlife species associated with herbaceous wetland habitat are primarily limited by the availability of suitable habitat in the Umatilla/Willow subbasin.
2. Suitable habitat for the Columbia spotted frog and other obligate species can be described by certain environmental conditions (i.e., the key environmental correlates described above).
3. The limiting factors described above negatively impact these wildlife species through their effect on the quality of herbaceous wetland habitat.
4. Management strategies that address these limiting factors will benefit wildlife species associated with herbaceous wetland by increasing the availability of suitable habitat.

Opportunities: The opportunities for improving herbaceous wetland habitat in ways that benefit the Columbia spotted frog and other obligate herbaceous wetland species are primarily dictated by current ownership and protection. As seen in Tables 69 and 70, most (86%) of the herbaceous wetland habitat in Umatilla/Willow subbasin is under no or low protected status and most (74%) is privately owned. Thus, these opportunities suggest that strategies aimed at increasing protection and enhancement by working with landowners, especially through cooperative programs and education, should be emphasized.

Table 69. Estimated protected status of herbaceous wetland habitat in the Umatilla/Willow subbasin.

High Protection	Medium Protection	Low Protection	No Protection
657 acres (14%)	12 acres (<1%)	140 acres (3%)	3,861 acres (83%)

Table 70. Estimated ownership of herbaceous wetland habitat in the Umatilla/Willow subbasin.

Federal Lands	Native American Lands	State Lands	NGO Lands	Private Lands
768 acres (18%)	118 acres (3%)	260 acres (6%)	0 acres (0%)	3,229 acres (74%)

Significant Data Gaps and Uncertainties: Several significant data gaps and uncertainties exist for herbaceous wetland habitat and its associated wildlife in the Umatilla/Willow subbasin. To fill these gaps, the following actions are needed:

- Obtain data on the quality of herbaceous wetland habitat in the Umatilla/Willow subbasin, including data on ecological function as related to the Columbia spotted frog and other obligate species.
- Refine and field-truth data on the location, size, spatial distribution, ownership, and protected status of herbaceous wetlands in the subbasin.
- Identify areas in the subbasin that could be converted to herbaceous wetland habitat to enlarge existing wetlands, provide new reservoir habitat, or enhance connectivity between two or more extant wetlands.
- Generate population and distribution data for the Columbia spotted frog and other species associated with herbaceous wetlands in the Umatilla/Willow subbasin.
- Determine the amount of high quality herbaceous wetland habitat needed to support viable populations of the Columbia spotted frog in the subbasin.

RIPARIAN WETLANDS

Focal Species: Great Blue Heron, Yellow Warbler, and American beaver

Habitat Status: The amount of riparian wetland presently occurring in the Umatilla/Willow subbasin is uncertain. Credible estimates of existing riparian wetlands range from 1,137 acres to 11,020 acres, compared to an historic estimate of approximately 80,000 acres (Table 71) (see Section 3.4.2 for a detailed description of the sources of these estimates). Several studies support the conclusion of subbasin planners that the quality of remaining riparian wetland habitats has declined, although no quantitative data on historic riparian wetland habitat of the subbasin are available.

Table 71. Estimated acreages of historic and current riparian wetland habitat in the Umatilla/Willow subbasin.

Historic Acreage (Historic Percent)	Current Acreage (Current Percent)	Change in Acreage (Percent Change)
~80,000 acres (3%)	1,137 – 11,020 acres (<1%)	-68,980 to -78,863 acres (-86% to -99%)

Limiting Factors: Major factors affecting riparian wetlands in the Umatilla/Willow subbasin are agricultural and urban development, exotic weed invasion, timber harvest, livestock grazing, transportation corridors, hydropower, and recreational activities. Hydropower, agricultural, urban, and transportation corridor development have led to habitat loss through conversion and channelization, have resulted in the separation of the floodplain from the stream, and have contributed to the degradation and fragmentation of remaining riparian habitat. Most of the extensive cottonwood galleries once found in riparian wetlands of the subbasin have been harvested. Existing riparian wetlands also continue to be degraded by exotic plant invasions and livestock grazing.

Desired Future Conditions: The desired future condition of riparian wetland habitat in the Umatilla/Willow subbasin is to have a sufficient amount of high quality habitat to support healthy populations of Great Blue Heron, Yellow Warbler, and American beaver and other riparian wetland obligates. High quality habitat for these species is currently understood to be habitat with the following key environmental correlates:

- 40-60% tree canopy closure of cottonwood or other hardwood species
- multi-structure/age tree canopy (including trees 6 inches dbh and mature/decadent trees)
- woody tree groves > 1 acre and within 800 feet of water, where applicable
- vegetation within 328 feet of shoreline
- 40-80% native shrub cover, with more than 50% of shrub species being hydrophilic
- multi-structured shrub canopy > 3 ft tall

Working Hypothesis: The key assumptions that make up the working hypothesis for riparian wetland habitat are:

1. Wildlife species associated with riparian wetland habitat are primarily limited by the availability of suitable habitat in the Umatilla/Willow subbasin.
2. Suitable habitat for the Great Blue Heron, Yellow Warbler, and American beaver and other obligate species can be described by certain environmental conditions (i.e., the key environmental correlates described above).
3. The limiting factors described above negatively impact these wildlife species through their effect on the quality of riparian wetland habitat.
4. Management strategies that address these limiting factors will benefit wildlife species associated with riparian wetlands by increasing the availability of suitable habitat.

Opportunities: The opportunities for improving riparian wetland habitat in ways that benefit the Great Blue Heron, Yellow Warbler, and American beaver and other obligate riparian wetland species are primarily dictated by current ownership and protection. Table 72 shows estimates of protected status from two sources (see Section 3.2.4.2 for details); both agree that the large majority of existing riparian wetlands in the subbasin have no protection. However, the ownership of these wetlands is unclear; one source (IBIS 2004) suggests that most riparian wetlands are found on CTUIR lands and the other (Kagan et al. 2000) suggests that most are privately owned (Table 73). This information points to the great need of employing strategies that increase protected status of riparian wetlands in the subbasin, either primarily through CTUIR or private landowners.

Table 72. Estimated protected status of riparian wetland habitat in the Umatilla/Willow subbasin.

High Protection	Medium Protection	Low Protection	No Protection
(0%)	(2%)	(0-4%)	(94-98%)

Table 73. Estimated ownership of riparian wetland habitat in the Umatilla/Willow subbasin.

Federal Lands	Native American Lands	State Lands	NGO Lands	Private Lands
(2-7%)	(1-64%)	(0-3%)	(0%)	(26-97%)

Significant Data Gaps and Uncertainties: Several significant data gaps and uncertainties exist for riparian wetland habitat and its associated wildlife in the Umatilla/Willow subbasin. To fill these gaps, the following actions are needed:

- Supplement, refine, and field-truth existing data on the location, size, spatial distribution, and protected status of riparian wetlands in the subbasin. Reconcile differences in estimates of ownership of riparian wetlands in the subbasin.
- Obtain data on the quality of riparian wetland habitat in the Umatilla/Willow subbasin, including data on ecological function as related to the Great Blue Heron, the Yellow Warbler, and the American beaver and other obligate species. Use these data to create maps of habitat suitability for the Great Blue Heron, the Yellow Warbler, and the American beaver.
- Identify areas in the subbasin that could be converted to riparian wetland habitat to enlarge habitat patches, provide new reservoir habitat, or enhance connectivity between two or more extant patches.
- Generate population and distribution data for the Great Blue Heron, Yellow Warbler, and American beaver and other species associated with riparian wetland in the Umatilla/Willow subbasin.
- Determine the amount of high quality riparian wetland habitat needed to support viable populations of the Great Blue Heron, Yellow Warbler, and American beaver in the subbasin.

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Section 4. Inventory

Table of Contents

4. Inventory of Existing Activities

The following section contains information derived from an inventory questionnaire that was sent to approximately 50 organization tied to Umatilla Subbasin natural resource use and management. The questionnaire and responses are found in Appendix F.

4.1 Existing Legal Protections

Table 1 lists important legal protections, and the governmental level at which the laws have been enacted and enforced, that affect fish and wildlife in the Umatilla/Willow subbasin. While not comprehensive, the list is considered the most important legal protections. Brief descriptions of these protections follow table 1.

Table 1 Summary of Existing Legal Protections

Level	Name
Federal	Clean Water Act
	Endangered Species Act
	Migratory Bird Treaty Act
	National Environmental Policy Act
	National Forest Management Act
	The Treaty of 1855
	Wilderness Act 1974
Oregon State	Oregon Department of Fish and Wildlife Regulations and Policies
	Oregon Division of State Lands Fill and Removal Laws
	Oregon Forest Practices Act – Oregon Department of Forestry
	Oregon Groundwater Protection Act
	Instream Water Rights – Oregon Water Resources Department
County	Morrow County Zoning Ordinance – Morrow County Planning Department
	Umatilla County Zoning Ordinance – Umatilla County Department of Resource Services and Development
Private Landowners	Conservation Easements – agreements between private landowners and ODFW and CTUIR
All Levels	Protected Lands through property ownership or lease agreements

Federal Legal Protections

Clean Water Act, 1972

The Clean Water Act is perhaps the most important legal protection of surface water quality in the United States. The act involves a variety of regulatory and non-regulatory tools to reduce pollutant discharge into surface waterways, finance municipal wastewater treatment facilities, and manage polluted runoff. These tools are employed to achieve the broad goal of restoring and maintaining the chemical, physical and biological integrity of the nation's waters so that they can support the protection and propagation of fish, shellfish, and wildlife and recreation on the water.

An important aspect of the Clean Water Act is the requirement in Section 303(d) for states to develop a list of all impaired waters. In addition, states are required to establish total maximum daily loads (TMDLs) for important pollutants and a water quality management plan (WQMP) designed to implement the TMDLs. A TMDL and WQMP were developed and approved for the Umatilla subbasin in 2001. Currently, a TMDL and WQMP are being developed for the Willow Creek subbasin.

The Clean Water Act also provides some protection for wetlands. Wetlands that meet the federal definition cannot be dredged or filled without a permit from the U.S. Army Corps of Engineers.

Endangered Species Act, 1973

The Endangered Species Act is administered jointly by the USFWS and NOAA Fisheries. NOAA Fisheries has responsibility for anadromous fish species warranting listing and the USFWS has responsibility for plant, wildlife, and freshwater fish species that warrant listing. The main purpose of the act is to protect endangered and threatened species and to provide a means to conserve their ecosystems.

Threatened and endangered species in the Umatilla/Willow subbasin are listed in Table 14 of section 3.2.1.1.

Migratory Bird Treaty Act, 1989

The Migratory Bird Treaty Act is a joint effort by the United States, Canada, Mexico, Japan, and the former Soviet Union to protect shared migratory bird species. Under the Act the taking, killing, or possession of migratory birds is unlawful.

National Environmental Protection Act (NEPA), 1969

This act requires all federal agencies to examine potentially adverse environmental effects of proposed actions that could affect the quality of the environment for humans. The agencies must also examine alternatives to the proposed action. NEPA is not regulatory; however, the environmental analysis involved reveals the existence of environmental problems and possible less-damaging alternatives (NRC 2002). Although NEPA applies only to proposed federal actions, it can extend to private actions if those require some form of federal approval or receive federal financing (NRC 2002).

National Forest Management Act, 1974

This act calls for the management of renewable natural resources on national forest lands. The act requires the Secretary of Agriculture to assess forest lands, develop management programs based on multiple-use, sustained-yield principles, and implement a resource management plan for each unit of the National Forest System. The act is the primary statute governing the administration of national forest lands. Portions of the Umatilla National forest are found in the Umatilla/Willow subbasin.

The Treaty of 1855
In 1855 the U.S. Government and the Walla Walla, Cayuse, and Umatilla tribes signed a treaty in which the tribes ceded more than 6.4 million acres in northeastern Oregon and southeastern Washington. In exchange a parcel of land (approximately 350,000 acres) in northeastern Oregon was set aside as a reservation for the three tribes. As part of the treaty, the tribes reserved the rights to fish, hunt, and gather traditional foods throughout the ceded lands.

The Wilderness Act, 1974
Congress passed this act to preserve wilderness areas for present and future generations. As part of the act, Congress established a National Wilderness Preservation System to be composed of federally-owned areas designated as "wilderness areas" and administered for the use and enjoyment of the American people in such a manner that they will be left unimpaired for future use as wilderness. Under the Wilderness Act, the use of motorized equipment and the building of permanent structures are prohibited.

State Legal Protections

Oregon Department of Fish and Wildlife Regulations and Policies
ODFW has numerous regulations designed to protect Oregon's fish and wildlife resources. These regulations include:

- Fish Management and Hatchery Operation (OAR Chapter 635, Division 007) – this includes regulations regarding native fish conservation, hatchery management, and fish health.
- Fish Passage Program (OAR Chapter 635, Division 412) – this regulation requires that any structures built in the state's waters must provide passage for migratory fish.
- Wildlife Diversity Program (OAR Chapter 635, Division 100) – this regulation provides the program goals, objectives and strategies to identify and coordinate non-game wildlife management, research and status survey needs, and education and recreation needs related to Oregon's wildlife.
- Fish and Wildlife Habitat Mitigation Policy (OAR Chapter 635, Division 415) – This policy provides the goals and standards for the mitigation of human activities that impact fish and wildlife habitat.
- Statewide Angling Regulations (OAR Chapter 635, Division 011-0050) – ODFW is required to annually monitor the status of fish and shellfish harvested for sport. From this monitoring, ODFW adopts annual rules prescribing season, bag limit, harvest methods, and other restrictions.

- Hunting Regulations (OAR Chaper 635, Division 051-080) – As with angling, ODFW is required to monitor the status of, and develop regulations for, wildlife harvested for sport.

A complete list and descriptions of Oregon Administrative Rules regarding fish and wildlife can be found at www.dfw.state.or.us/OARs/OARs.html.

Oregon Division of State Lands Fill and Removal Laws (OAR Chapter 14, Division 85)
Under this rule, the Oregon Division of State Lands works in conjunction with the Army Corps of Engineers, under section 404 of the Clean Water Act, to regulate the removal and filling of materials in wetlands and waterways.

Oregon Forest Practices Act (ORS 527 and OAR Chapter 629, Divisions 600-680), 1971
This act regulates forest management activities on state and private lands. The act is designed to maintain forest productivity and protect wildlife and water resources.

Oregon Groundwater Protection Act (ORS 468B.150-468B.190 and OAR Chapter 340, Division 40), 1989
This act focuses on preventing groundwater contamination while conserving groundwater for present and future beneficial uses. The law requires that ODEQ monitor groundwater quality conditions and to establish maximum measurable levels for groundwater contaminants. The act further requires the declaration of a Groundwater Management Area (GWMA) if groundwater contamination exceeds standards. In 1990, ODEQ declared 352,000 acres in Umatilla and Morrow counties as the Lower Umatilla Basin GWMA after discovering elevated nitrate levels in wells in the area.

Oregon Instream Water Rights Act (ORS 537.332-537.336 and ORS 537.350), 1987
This act provides for the purchase and legal protection of water rights for “public uses” that include recreation, pollution abatement, navigation, and the conservation and enhancement of aquatic life and wildlife. ODEQ, ODFW and the Oregon Parks and Recreation Department are the major purchasers of public use water rights.

County Legal Protections

Morrow County Zoning Ordinance Article 3 Section 3.100 Flood Hazard Overlay Zone
As authorized by the Federal Emergency Management Agency, this ordinance assures limited and appropriate development in floodplains in Morrow County. The importance to fish and wildlife of this ordinance is that it greatly limits the development of much of the floodplain and riparian areas in Morrow County.

Umatilla County Development Ordinance (Development Code 152)
This ordinance encompasses multiple provisions that impact fish and wildlife. These provisions include:

- Stream setback – This provision requires that all permanent structures including sewage disposal installations and septic tanks must be set back a minimum of 100 ft. from the high water mark of streams, lakes and wetlands.
- Riparian vegetation; wetland drainage – This provision states that "no more of a parcel's existing vegetation shall be cleared from the setback and adjacent area than is necessary for uses permitted with a zoning permit, accessory buildings, and/or necessary access." (Umatilla County Development Code 152.016)
- Floodplain ordinance – This provision prohibits any uses which are dangerous to human safety and property during times of floods. In addition, it requires that any buildings which serve uses vulnerable to floods be provided with flood protection at the time of construction. Finally, this provision protects individuals from buying lands which are unsuited for some purposes because of flood hazard.
- Natural Area Overlay Zone – This provision was developed to protect and preserve ecologically and scientifically significant natural areas, while providing an expedient process for reviewing land uses that may affect these areas when they are identified.
- Critical Winter Range Overlay Zone – This provision was developed to conserve and protect important elk and deer winter range in the county while allowing development at a density that will not significantly reduce the carrying capacity of these areas.

Legal Protections/Agreements Involving Private Landowners

Conservation Easements
A conservation easement is a legal agreement between a landowner and another party to maintain private lands for specified conservation purposes. The incentives to the landowner include continued ownership of the land, the ability to limit future uses of the land, receipt of fair market value for the easement, and, in some cases, tax incentives. Many of the projects conducted by the CTUIR and ODFW and designed to enhance fish and wildlife habitat involve conservation easements with private landowners. These projects are outlined below in the section

Protected Lands
Areas of the Umatilla/Willow subbasin have, through property ownership or special designation, protected status that limits the amount of human activity on those lands. Protected status in this plan corresponds to the definitions used for gap analyses generated by IBIS. Those definitions correspond to four categories of protection described in the USGS Gap Analysis Program Handbook (http://www.gap.uidaho.edu/handbook/Stewardship/status) (personal communication: C. Langhoff, NWHI, April 2004) that are defined as follows (after Scott et al. 1993, Edwards et al. 1994, Crist et al. 1996):

High Protected Status: An area having permanent protection from conversion of natural land cover and a mandated management plan in operation to maintain a natural state within which disturbance events (of natural type, frequency, intensity, and legacy) are allowed to proceed without interference or are mimicked through management.

Medium Protected Status: An area having permanent protection from conversion of natural land cover and a mandated management plan in operation to maintain a primarily natural state, but which may receive uses or management practices that degrade the quality of existing natural communities, including suppression of natural disturbance.

Low Protected Status: An area having permanent protection from conversion of natural land cover for the majority of the area, but subject to extractive uses of either a broad, low-intensity type (e.g., logging) or localized intense type (e.g., mining). It also confers protection to federally listed endangered and threatened species throughout the area.

No Protection: There are no known public or private institutional mandates or legally recognized easements or deed restrictions held by the managing entity to prevent conversion of natural habitat types to anthropogenic habitat types. The area generally allows conversion to unnatural land cover throughout.

Figure 1 shows the protected areas for the Umatilla/Willow subbasin. Areas with "high" protected status include:

- North Fork Umatilla River Wilderness Area (North Fork in Figure 1). This area was added to the Wilderness Preservation System (under the Wilderness Act of 1964) by the Forest Service in 1984. It encompasses 20,144 acres in the Blue Mountains. The North Fork Umatilla is an important spawning and rearing area for spring Chinook and steelhead and it is a stronghold for the North Fork Umatilla River bull trout population (see Section 3.2.3). In addition, the North Fork waters are some of the coldest in the subbasin and these waters help cool water in the upper mainstem.
- Army Chemical Depot (Army Depot in Figure 1). This area is one of the nation's largest storage facilities for mustard gas and sarin nerve gas as well as conventional munitions. The depot encompasses 19,728 acres of which 17,054 acres are owned by the Army and the remaining 2,600 acres have restrictive easements in place.
- Umatilla Wildlife Refuge (Umatilla Refuge in Figure 1). This 25,347 acre refuge is part of the National Wildlife Refuge System administered by the USFWS. This refuge was established in 1969 as mitigation for habitat loss resulting from the construction of the John Day Dam. It is managed to provide habitat for migratory birds and is located within the Pacific Flyway to provide Arctic nesting geese and ducks a wintering site and resting stopover during migration. In addition, bald eagles, osprey, and migratory songbirds are found in the refuge.
- Horne Butte. This area is managed by the BLM and represents the best remaining, intact bluebunch wheatgrass habitat in the subbasin, as well as sagebrush and grassland habitats. The area includes the only habitat for the endangered plant, sessile mouse-tail. Its proximity to additionally protected lands in the Boardman Bombing Range helps maintain populations of pronghorn and Washington Ground Squirrel which are rare in the subbasin.

- Boardman Bombing Range and Boeing Lease Lands (Boeing in Figure 1). This large area includes 23,000 acres administered by The Nature Conservancy since 1978 and is also referred to as the Boardman Grasslands or Boardman Research Natural Area. This site contains the best remaining areas of sandy bunchgrass and open sand dune habitat in the entire Columbia Basin. In addition, it includes habitat for the Washington ground squirrel.
- Lost Prairie Preserve. This is a 23 acre area managed by the BLM south of the Boardman Bombing Range.
- Umatilla National Forest. This area is found throughout the Blue Mountains in the subbasin and is subject to the multiple uses of national forests.
- Wanaket Wildlife Area. This area is not shown in Figure 1. This is a 2,817 acre reserve found near the Columbia River between Umatilla and Hat Rock state park. The land is owned by BPA and managed by CTUIR in conjunction with Oregon Duck Hunters Association, Duck's Unlimited and Pheasants Forever. The area is valuable open water and marsh habitat for migratory birds.
- Iskuulpa Creek. This area is not shown in Figure 1. The CTUIR purchased the upper portion of the Iskuulpa Creek watershed from private landowners for the sole purpose of creating a wildlife refuge and improving conditions in Iskuulpa Creek for steelhead and salmon.

Other protected areas include conservation easements (described above) between private landowners and both the CTUIR and ODFW. These areas are managed as habitat enhancement "projects" by the CTUIR and ODFW and are covered below under Section 4.4.

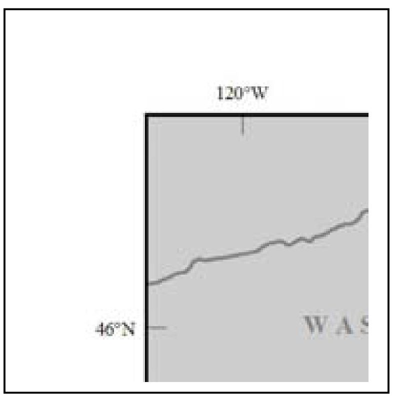

Figure 1. Protected areas in the Umatilla/Willow subbasin. Figure from IBIS 2004.

4.2 Existing Plans

Table 2 lists existing management plans [illegible]d entities, important in the Umatilla/Willow subbasin. A brief de[illegible]ach plan follows Table 2.

Table 2. Existing plans in the Umatilla/Willow subbasin.

Lead Entity	Plan
Columbia River Intertribal Fish Commission (CRITFC)	Wy-Kan-Ush-Mi Wa-Kish-Wit
CTUIR	[illegible]nagement Plan for the Umatilla Indian Reservation
CTUIR	Meacham Creek Watershed Analysis and Action Plan
CTUIR	A Program to Manage Rangeland and Pasture Resources on the Umatilla Indian

	Reservation
NOAA Fisheries	Hatchery Genetics Management Plans
ODA	Umatilla River Subbasin Agricultural Water Quality Management Area Plan and Willow Creek Agricultural Water Quality Management Area Plan (1010 plans)
ODEQ	Umatilla River Basin TMDL and Water Quality Management Plan
ODEQ	Water Quality Management Plan (Morrow County)
ODEQ, ODA, and Umatilla County	Lower Umatilla Basin GWMA Voluntary Plan
ODFW	Fish Management Plans
ODFW	Game Species Management Plans
ODFW	Oregon Wildlife Diversity Plan
ODFW	Vision 2006
State of Oregon	Oregon Plan for Salmon and Watersheds
Umatilla County	Umatilla County's Comprehensive Plan
Umatilla National Forest	Land and Resource Management Plan
Umatilla National Forest	Umatilla and Meacham Ecosystem Analysis
USFS and USDI BLM	Interior Columbia Basin Ecosystem Management Project (ICBEMP)
USFS and USDI BLM	PACFISH
USFWS	Draft Bull Trout Recovery Plan

Wy-Kan-Ush-Mi Wa-Kish-Wit – Spirit of the Salmon

This plan was developed in 1995 by CRITFC as a general anadromous fish restoration plan for the Columbia River basin. The plan emphasizes strategies meant to enhance natural production and healthy river systems. Some specific objectives of the plan include:

- halting the decline of salmon, lamprey, and sturgeon populations above Bonneville Dam within seven years.
- rebuilding salmon populations of annual run sizes of four million above Bonneville Dam within 25 years to support ceremonial, subsistence and commercial harvests.
- increasing lamprey and sturgeon populations within 25 years to support tribal harvest.

Forest Management Plan for the Umatilla Indian Reservation

The CTUIR developed a management plan for forest land on the reservation in 2003. This plan outlines the sustainable use of forest lands and emphasizes uses and strategies that minimize impacts to fish and wildlife habitat.

Meacham Creek Watershed Analysis and Action Plan
In 2003 a report was provided by private contractors to the CTUIR regarding Meacham Creek. The report evaluated current conditions in creek for fish and compared that to assumed pre-European settlement conditions. The report also provided a series of actions designed to improve conditions in Meacham Creek for fish.

A Program to Manage Rangeland and Pasture Resources on the Umatilla Indian Reservation
The CTUIR developed a management plan in 2001 for the sustainable use of rangeland and pasture resources on the reservation. The plan emphasizes uses of these lands that minimize impacts to fish and wildlife resources.

Umatilla River Subbasin Agricultural Water Quality Management Area Plan and Willow Creek Agricultural Water Quality Management Area Plan
These plans are in accordance with senate bill 1010 and provide guidance for addressing agricultural water quality issues. The plan provides strategies to reduce water pollution from agricultural lands through a combination of educational programs, suggested land treatments, management activities, and monitoring. The Umatilla River plan was developed in 1999 and the Willow Creek plan was developed in 2003.

Umatilla River Basin TMDL and Water Quality Management Plan
The TMDL sets permissible levels of pollutants that protects beneficial uses of water. In the Umatilla subbasin these beneficial uses include drinking water, contact recreation, and uses related to steelhead, salmon and trout populations. More information on important pollutants, reaches listed as being water quality limited, and the TMDL can be found in Section 3.1.2.2 of the Assessment. The Water Quality Management Plan (WQMP) guides the implementation of the TMDL goals. The Umatilla River Basin TMDL and WQMP were approved in 2001. A TMDL is currently being developed by ODEQ for the Willow Creek subbasin.

Lower Umatilla Basin GWMA Voluntary Plan
Under the Oregon Groundwater Protection Act, ODEQ declared, in 1990, 352,000 acres in Umatilla and Morrow counties as the Lower Umatilla Basin GWMA after discovering elevated nitrate levels in wells in the area. The voluntary plan seeks solutions to protect the area's groundwater by bringing the level of nitrate-nitrogen in the groundwater below 7 mg/l.

Fish Management Plans
These plans were developed by ODFW and are meant to implement policy and to provide an explanation of the intent and rationale behind management directions. Legally-

enforceable rules contained in the plans are found in OAR 635, Division 500 (see above Section 4.1).

Game Species Management Plans
ODFW has a variety of management plans for game species that apply to the subbasin. These plans include:

- Mule Deer Management Plan
- Elk Management Plan
- Cougar Management Plan
- Black Bear Management Plan
- Oregon Migratory Game Bird Program Strategic Management Plan

Oregon Wildlife Diversity Plan
This ODFW plan is designed to conserve the diversity of fish and wildlife species in the state. The plan provides information on the needs of Oregon's native fish, amphibians, reptiles, birds, and mammals and contains information on all species and habitats in the state. The plan was first adopted in 1986 and was last updated in 1999.

Vision 2006
In 2000 ODFW developed this six year plan designed to provide a foundation for new initiatives and visions, statutory authority, and financial outlook through 2006.

Oregon Plan for Salmon and Watersheds
This statewide plan was developed by the Governor's Natural Resources office in 1997. The plan is represents an effort to develop community partnerships within subbasins to address water quality and salmon related issues.

Umatilla County's Comprehensive Plan
This plan applies specific land use goals to aid in conservation and preservation of lands, including those having a direct impact on fish and wildlife in the Umatilla River subbasin. These goals include:

- provide the basis of support for programs such as Soil and Water Conservation management practices that deter activities such as overgrazing.
- implement a conservation plan for grazing/forested areas vital to wildlife and watershed well-being.
- establish the Natural Area and Critical Winter Range overlay zones (see Section 4.1)
- establish water quality/quantity and pollution abatement measures.

Land and Resource Management Plan
This plan was adopted in 1990 by the Umatilla National Forest. The plan provides legal definitions for aquatic habitat, riparian, old growth, scenic, and wildlife designations. The plan also develops goals and strategies for sustainable and multiple uses of the national forest.

Umatilla and Meacham Ecosystem Analysis

This is an on-going analysis conducted by the Umatilla National Forest of the area of the Meacham Creek watershed found within the national forest. The analysis examines current and assumed historic conditions for fish and wildlife and develops strategies to maintain and improve fish and wildlife habitat in this watershed.

Interior Columbia Basin Ecosystem Management Project (ICBEMP)
This plan began in 1993 and was designed to develop a scientifically sound ecosystem management strategy for the interior Columbia basin. A final draft was developed in 2000 and in 2003 the US Forest Service, BLM, USFWS, NMFS, and the EPA signed a memorandum of understanding agreeing to implement the strategy developed by the project.

PACFISH – Environmental Assessment for the Implementation of Interim Strategies for Managing Anadromous Fish-producing Watersheds in Eastern Oregon and Washington, Idaho, and portions of California
This strategy was developed by the US Forest Service and BLM as an interim management plan for anadromous fish-producing watersheds on federal lands. The strategy was applied in eastern Oregon in 1995 and supersedes forest plans.

Draft Bull Trout Recovery Plan
The USFWS develops ongoing bull trout recovery plans. A 2004 *Bull Trout* Salvelinus confluentus *Draft Recovery Plan, Chapter 10, Umatilla – Walla Walla* is the latest iteration of this process. The plan provides a population risk assessment, identifies limiting factors, and outlines goals and strategies to improve population size and productivity. Sections of this plan form part of the Subbasin Plan's Management Plan (see Section 5.3.2).

Hatchery Genetics Management Plans (HGMPs)
The goal of HGMPs are to ensure that production activities in Columbia River subbasins are in compliance with the ESA and that reforms are identified to reduce the risk to naturally spawning populations and improve the survival of naturally and artificially produced fish. Hatchery reforms also include hatchery modifications intended to better define and achieve production and harvest objectives that are not necessarily related to ESA. Current draft HGMPs for the Umatilla River subbasin on steelhead, spring Chinook, fall Chinook, and coho are provided in Appendix G.

4.3 Existing Management Programs

Existing management programs are outlined in Table 3. A brief description of each program follows Table 3.

Table 3. Existing management programs in the Umatilla/Willow subbasin.

Lead Entity	Plan
City of Pendleton	Hazardous Materials Training for Public Works Employees

NRCS and US FSA	Farm Bill Programs

Hazardous Materials Training for Public Works Employees
The Hazardous Materials Training for Public Works Employees was a program which provided hazardous material spill response training for municipal and county public works employees, enabling them to assess a spill hazard and respond accordingly. The program, which was completed in July, 2003, was designed to address concerns that surfaced during the Umatilla Basin Total Maximum Daily Load and Water Quality Management Plan's preparation. Specifically, it was recognized that public works employees throughout the Umatilla Basin needed to better understand how to handle hazardous materials spills both from their own equipment and from other sources. One of the goals of the program was to enhance and protect riparian areas and streams by preventing runoff from hazardous chemical spills that could convey pollutants into these systems.

Farm Bill Programs
Several Farm Bill programs designed for developing projects for conservation and restoration are active in the Umatilla/Willow subbasin.

Environmental Quality Incentives Program (EQIP): EQIP is a voluntary program for farmers and ranchers that promotes agricultural production and environmental quality as paired national goals. EQIP offers financial and technical help to assist eligible participants install or implement structural and management practices on agricultural land.

Conservation Reserve Program (CRP): CRP provides technical and financial assistance to eligible farmers and ranchers to address soil, water, and related natural resource concerns on their lands in an environmentally beneficial and cost effective manner. The program provides assistance to farmers and ranchers in complying with federal, state, and tribal environmental laws, and encourages environmental enhancement.

Conservation Reserve Enhancement Program (CREP): CREP is a voluntary program for agricultural landowners. Unique state and federal partnerships allow landowners to receive incentive payments for installing specific conservation practices. Through CREP, farmers can receive annual rental payments and cost-share assistance to establish long-term, resource conserving covers on eligible lands.

Wildlife Habitat Incentives Program (WHIP): WHIP is a voluntary program for people who want to develop and improve wildlife habitat on private land. Through WHIP the NRCS provides both technical and financial cost-share assistance to establish and improve fish and wildlife habitat.

4.4 Existing Projects

Existing conservation and management projects are shown in Table 4. These projects are found throughout the subbasin and many are designed to improve habitat and water quality for steelhead and salmon.

Table 4. Existing conservation and management projects in the Umatilla/Willow subbasin.

Project Name	Lead Entity	Limiting Factors
CRP	USDA Farm Service and NRCS	Water Quality, Wildlife Habitat
Small Grant Stream Protection	Morrow County SWCD	Water Quality – protection from livestock
Animal Feeding Operation/ Confined Animal Feeding Operation	Columbia Blue Mountain Resource Conservation and Development Council (RC&D)	Water Quality – improvements to feedlots
Willow Creek WS Feeding Area Improvement	Morrow County SWCD	Water Quality – improvement to feedlots
Willow Creek Water Measuring Device Installation	Morrow County SWCD	Water Quality, Water Quantity
Lower Willow Creek Weed Management Area	Morrow County SWCD, The Nature Conservancy	Invasive Species
Navy Bombing Range Weed Control	Morrow County SWCD	Invasive Species
Wilson Creek Stream Restoration and Enhancement	Morrow County SWCD	Fish Passage Barrier
Fish Friendly Cattle Guards	Morrow County SWCD	Fish Passage Barrier
City of Pendleton Water Supply Development Projects	Bob Patterson, Pendleton Public Works Director	Water Quality (temperature)
CTUIR Umatilla River Basin Anadromous Fish Habitat Enhancement Projects – Riparian Function	CTUIR	Water Quality, Fish Habitat, Wildlife Habitat
Table 4, continued.		
Project Name	**Lead Entity**	**Limiting Factors**
CTUIR URB AFHE Project – Instream and Stream Bank Improvements	CTUIR	Fish Habitat, Fish Passage Improvements, Water Quality (sediment)
Umatilla River Subbasin Fish Habitat Improvement Program	ODFW	Fish Habitat, Water Quality, Wildlife Habitat
North and South Fork Umatilla River Structure Repair	Umatilla National Forest	Fish Habitat
OWEB Small Grants – Convert from flood	Morrow County SWCD	Water Quality, Water Quantity

irrigation to sprinkler		
OWEB Small Grants—Livestock disbursement, water facility, spring development	OWEB, Morrow County SWCD	Rangeland health
EQIP Direct Seed	NRCS	Water Quality, Soil erosion
EQIP Riparian/Range Improvements	NRCS	Water Quality, Fish Habitat, Wildlife Habitat
Wildlife Watering Facilities	NRCS and Morrow County SWCD	Water Availability for Upland Wildlife
Reseed After Weed Control	Morrow County SWCD	Noxious weeds impact on grasslands – reseeded rangelands and pastures
Wildlife Habitat Incentive Program (WHIP)	Chet Hadley	Wildlife Habitat
Stewards of the Umatilla River Environment	Betty Klepper	Water Quality, Wildlife Habitat (riparian areas in Pendleton) including bird nesting boxes
Butter Creek Range and Riparian Enhancement Project	Umatilla County SWCD	Water Quality (sediment and bacteria)
SWCD District Seeding Incentive Program	Umatilla County SWCD, OSU Extension, NRCS	Water Quality (sediment)
Umatilla Basin Project	BOR and numerous partners and cooperators	Water Quality (temperature), Water Quantity

4.5 Gap Analysis

The gap analysis was designed to examine whether existing projects designed to improve aquatic focal species habitats have targeted the appropriate limiting factors and the priority geographic areas as determined by the current EDT analysis. The data used for the gap analysis involved 52 on-the-ground projects conducted by the CTUIR, 28 conducted by ODFW and 4 conducted by USFS.

All of these projects involved restoration of steelhead and salmon habitat through riparian improvements and/or instream improvements. These projects are considered to address the following limiting factors: low flow, channel stability, habitat diversity, key habitat quantity, sediment load, chemicals, high temperature, and food availability. Figures 2 through 5 were drawn to illustrate gaps for each anadromous focal species based on where projects occurred, what important limiting factors were addressed in those areas and whether areas with restoration correspond to high priority areas determined by the EDT analysis.

In general, the gap analysis indicates that many of the priority areas are also areas in which restoration has occurred. For steelhead, 9 of the 15 top priority areas for restoration had projects; for spring Chinook, 6 of the 10 top priority areas had projects; for fall Chinook, 2 of the 4 top priority areas had projects, and for coho, 6 of the 7 top priority areas had projects. These projects also addressed the most important limiting factors -- sediment load, high temperatures, key habitat quantity, and habitat diversity. However, eight identified priority GAs have not received any projects based on this inventory. In addition, by definition, priority GAs have important limiting factors and thus even those with projects still require further attention based on the current EDT analysis.

While this gap analysis provides a means for determining whether existing projects have been targeting the appropriate limiting factors in the desirable areas (which, for the most part, appears to be true) the results must be interpreted with great caution and must not be "over-interpreted." There is a disconnect between when projects began and what conditions were like at that point versus the conditions derived by EDT (which is based on a conglomeration of data that ranges from 1 year to approximately 10 years old). This makes it difficult to determine whether actual "gaps" exist or are simply artifacts of this mismatch. In addition, there is the possibility that the results might be used to make statements regarding the effectiveness of restoration techniques. For example, GA33 has 26 projects (Figure 2) and yet is a priority GA base on temperature and habitat quantity. An inappropriate conclusion from this might be that our restoration projects do not work; however, since we are unaware of the "EDT" conditions in this area when the existing projects were put into place (up to 20 years ago). Thus, the gap analysis cannot be used to evaluate existing projects and highlights the need in the subbasin for appropriate monitoring and evaluation of projects. This point cannot be emphasized strongly enough. If we are to use the principles of adaptive management we must learn from the projects we are implementing through rigorous and scientifically sound monitoring and evaluation methodologies (see Section 5.6).

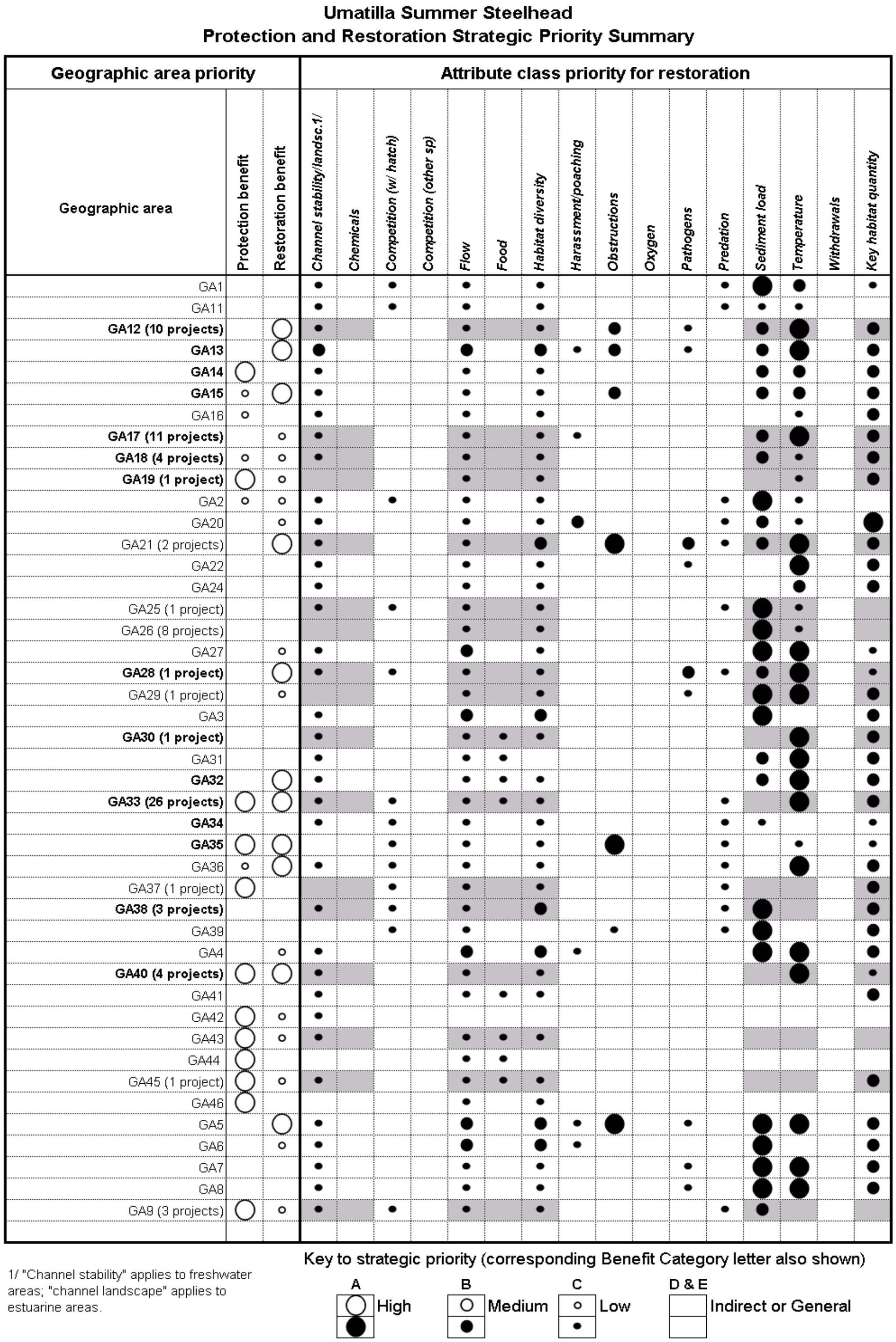

Figure 2. Gap analysis for steelhead. GAs in bold are priority areas for restoration. Shaded squares indicate where restoration has occurred and what limiting factors it has addressed. Black circles indicate that in the appropriate GA, the limiting factor has a negative impact on the focal species, and the size of the circle indicates the degree of effect. The number of projects is given in parentheses next to the GAs in which projects have occurred.

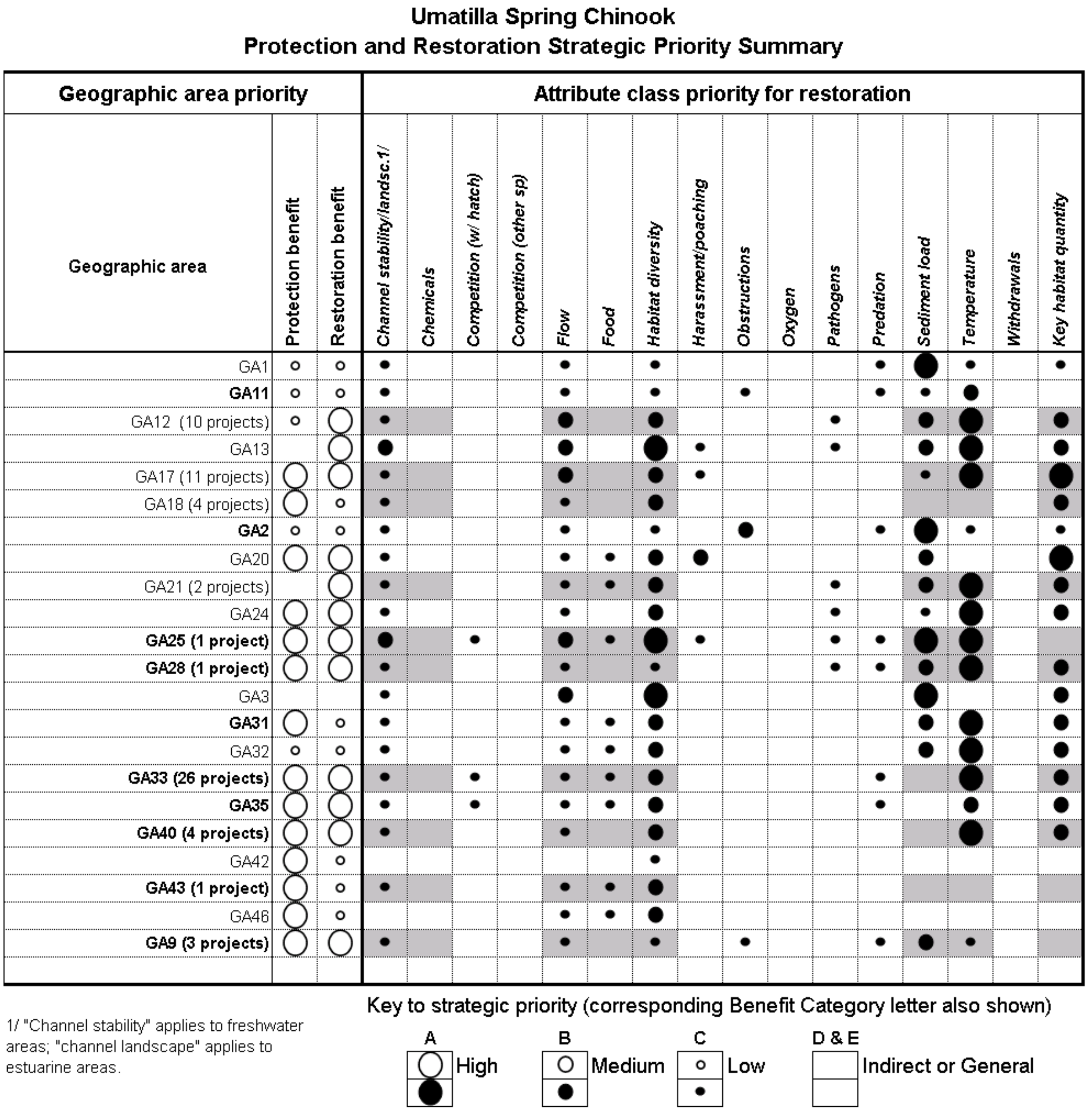

Figure 3. Gap analysis for spring Chinook. Shading, bold print, and circles same as in figure 2.

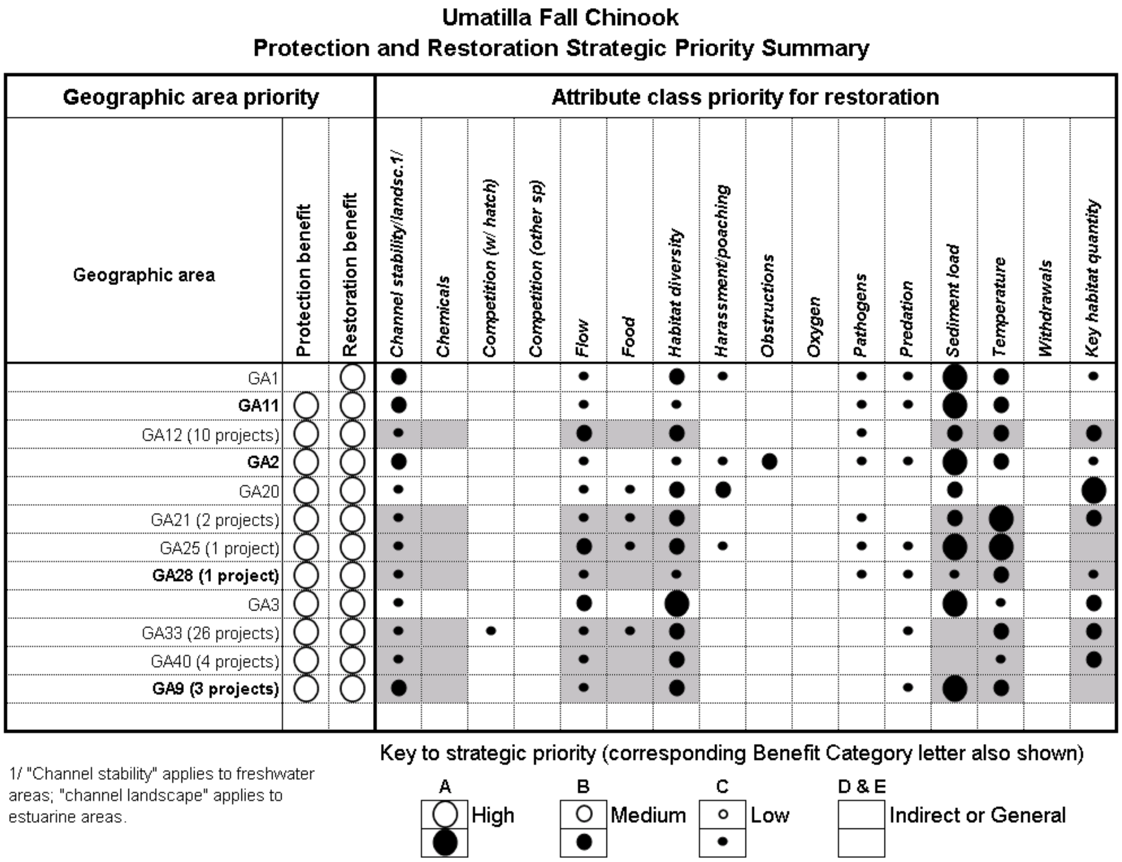

Figure 4. Gap analysis for fall Chinook. Shading, bold print, and circles same as in figure 2.

Umatilla Coho
Protection and Restoration Strategic Priority Summary

Geographic area priority			Attribute class priority for restoration															
Geographic area	Protection benefit	Restoration benefit	*Channel stability/landsc.1/*	*Chemicals*	*Competition (w/ hatch)*	*Competition (other sp)*	*Flow*	*Food*	*Habitat diversity*	*Harassment/poaching*	*Obstructions*	*Oxygen*	*Pathogens*	*Predation*	*Sediment load*	*Temperature*	*Withdrawals*	*Key habitat quantity*
GA1		Low	High		Low		Low		High	Low				Low	High	High		Low
GA11		High	Medium		Low		Low		Low					Low	High	High		
GA12 (10 projects)	Low	High	Low				Medium		Low						Medium	High		Medium
GA13		Low	High				Medium		Medium	Low					Medium	High		Medium
GA14	High		Low				Low		Medium						Low			Medium
GA15	Low	Low	Medium				Medium		High							Medium		Medium
GA17 (11 projects)	High	Low	Medium				Medium		Medium						Low	Low		Medium
GA18 (4 projects)	High		Low				Medium	Low	Low									Medium
GA19 (1 project)	High	Low	Low				Medium		Medium									Medium
GA2		High	High		Low		Low		Medium	Low	Low			Low	High	Medium		Low
GA20			Low				Low	Low	Low	Medium					Medium			High
GA21 (2 projects)		High	Low				Low	Low	Medium						Medium	High		Medium
GA22		Low	Medium				Medium	Low	High							Medium		Medium
GA24	High	Low	Low				Medium		Medium							Medium		Medium
GA25 (1 project)		High	Medium		Medium		Medium	Low	High	Low				Low	Medium	High		Low
GA26 (8 projects)		High	Low				Medium		Medium						High	Medium		Medium
GA28 (1 project)	High	High	Low		Low		Low		Low					Low	Medium	High		Low
GA3									Medium									Low
GA30 (1 project)	Low	Low	Low				Medium	Low	Medium							Low		Medium
GA31	High	Low	Low				Low	Low	Low						Medium	Low		Medium
GA32	High		Low				Low	Low	Low						Medium	Low		Medium
GA33 (26 projects)	High	High	Low		Low		Low	Low	Medium					Low		Medium		Medium
GA35	High				Low		Low		Medium					Low		Low		Low
GA4		High	Low				Medium		Medium	Low					High	Low		Medium
GA40 (4 projects)	High	Low	Low				Low		Medium							Low		Medium
GA42	High								Medium									
GA43 (1 project)	Low		Low				Low	Low	Medium									
GA46							Low	Low	Low									
GA5		High	Medium				Medium		Medium	Low					Medium	High		Medium
GA7	Low	High	Low				Low		Low						Medium	High		Medium
GA8	Low	High	Low				Medium		Medium						Medium	Low		Medium
GA9 (3 projects)		High	Medium		Low		Low		Medium					Low	High	Medium		

1/ "Channel stability" applies to freshwater areas; "channel landscape" applies to estuarine areas.

Key to strategic priority (corresponding Benefit Category letter also shown)

A	B	C	D & E
High	Medium	Low	Indirect or General

Figure 5. Gap analysis for coho. Shading, bold print, and circles same as in figure 2.

Section 5. Management Plan

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5. Management Plan

5.1 General Approach and Methods

The logic path used by subbasin planners in developing the management plan is summarized in Figure 1. The management plan for the Umatilla/Willow subbasin begins with a vision statement (Section 5.2), which describes the desired future condition of the subbasin and reflects the current conditions, values, and priorities of the subbasin in a manner that is consistent with the Council's vision described for the Columbia basin (Council 2000). The Umatilla/Willow subbasin vision statement was adopted by the Core Partnership on November 6, 2003 and was presented and approved at a public meeting on November 12, 2003.

The development of objectives and strategies for the subbasin's aquatic and terrestrial wildlife management plan was driven by the vision, the current biological and ecological conditions in the subbasin, and the economic and social realities described in the assessment (Section 3.0). The biological objectives describe the physical and biological changes within the subbasin needed to achieve the vision. When forming aquatic and wildlife biological objectives, subbasin planners worked to satisfy the criteria set forth by the Council (2001) in its *Technical Guide to Subbasin Planners*. Thus, biological objectives in this plan are:

- empirically measurable and based on an explicit scientific rationale
- both short-term and long-term
- consistent with basin-level visions, objectives, and strategies adopted in the Council's program
- consistent with legal rights and obligations of fish and wildlife agencies and tribes with jurisdiction over fish and wildlife in the subbasin, and agreed upon by co-managers in the subbasin
- complementary to programs of tribal, state and federal land or water quality management agencies in the subbasin
- consistent with the ESA recovery goals and CWA requirements
- quantitative with measurable outcomes where appropriate

Strategies developed for the Umatilla/Willow subbasin describe sets of actions needed to accomplish the biological objectives. They take into account not only the desired outcomes, but the physical and biological realities expressed in the working hypotheses, and are meant to guide the development of projects as part of the implementation of the plan. When possible, strategies are prioritized. A limited set of aquatic and terrestrial objectives and strategies was presented at a public meeting on May 6, 2004, and suggestions provided at that meeting were incorporated into the plan.

Adaptive management will be used to refine and modify objectives and strategies throughout the implementation of the Umatilla/Willow subbasin plan. Important data gaps and critical uncertainties became evident as the subbasin assessment and inventory were completed and are described in detail in Sections 4.5 and 5.5. As these gaps are filled, objectives and strategies will be modified, as needed. Another necessary component of adaptive management is a strong monitoring and evaluation program. The inventory clearly illustrates the difficulties that arise in the absence of coordinated, well-funded monitoring and evaluation programs for appraising the effectiveness of fish and wildlife efforts. To address this deficiency, this plan includes a detailed monitoring and evaluation program (Section 5.5 and Appendix H). If properly funded, the implementation of this program will be pivotal for successful adaptive management.

Finally, it should be noted that the objectives and strategies presented in this plan are consistent with the scientific principles that underlie the Council's Fish and Wildlife Program (Table 1).

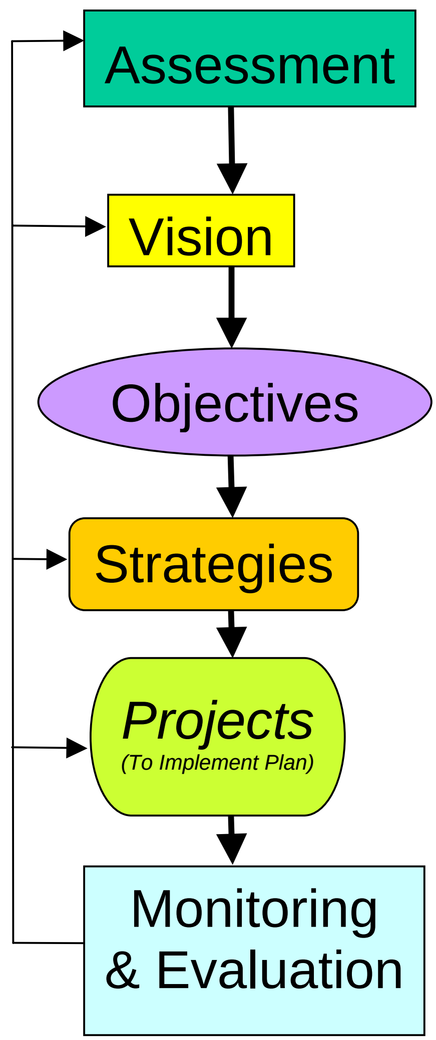

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Figure 1. Flowchart of the logic path used to develop the Umatilla/Willow subbasin plan (modified from ISRP 2004).

Table 1. Scientific principles of the Council's Fish and Wildlife Program. Detailed descriptions of each principle are available in Council, 2000.

Scientific Principles
Principle 1: The abundance, productivity, and diversity of organisms are integrally linked to the characteristics of their ecosystems.
Principle 2: Ecosystems are dynamic, resilient, and develop over time.
Principle 3: Biological systems operate on various spatial and time scales that can be organized hierarchically.
Principle 4: Habitats develop and are maintained by physical and biological processes.
Principle 5: Species play key roles in developing and maintaining ecological conditions.
Principle 6: Biological diversity allows ecosystems to persist in the face of environmental variation.
Principle 7: Ecological management is adaptive and experimental.
Principle 8: Ecosystem function, habitat structure, and biological performance are affected by human actions.

5.2 Vision for the Subbasin

The vision for the Umatilla/Willow subbasin is a healthy ecosystem with abundant, productive, viable, and diverse populations of aquatic and terrestrial species, which will support sustainable resource-based activities that contribute to the social, cultural, and economic well-being of the communities within the subbasin and the Pacific Northwest.

This vision entails several broad goals for the subbasin that can be categorized as human use; habitat; population; and research, monitoring, and evaluation goals.

Human Use

- Provide for non-consumptive recreational, educational, aesthetic, scientific, economic, cultural, and religious uses of the subbasin's diverse fish and wildlife resources.
- Provide for sustainable consumptive, ceremonial, subsistence, and recreational uses of the subbasin's diverse fish and wildlife resources.
- Provide for sustainable resource-based activities to support the economies and cultures of the communities within the subbasin.

Habitat

- Protect existing high quality fish and wildlife habitat and strongholds.
- Restore and enhance degraded and diminished fish and wildlife habitats to support population restoration goals and to mitigate impacts from the construction and operation of the Columbia basin hydropower system and other anthropogenic impacts.
- Restore the health and function of ecosystems in the Umatilla/Willow subbasin to ensure continued viability of their natural resources.

Population
- Maintain and enhance the diversity, abundance and productivity of existing fish and wildlife populations within the subbasin.
- Strive for de-listing and avoidance of future listings of native fish and wildlife species in the subbasin under state and federal Endangered Species Acts.
- Restore and maintain self-sustaining populations of extirpated species consistent with habitat availability, public acceptance, and other uses of the lands and waters of the state.

Research, Monitoring, and Evaluation
- Develop a research, monitoring, and evaluation plan for the ecosystems of the subbasin that is consistent with and complements the larger regional efforts to track the status of fish and wildlife populations and their habitats as needed for appraising management actions, the results of these actions, and for evaluating other environmental changes.

5.3 Aquatic Biological Objectives and Strategies

5.3.1 Aquatic Approach and Methods

As described in Section 5.1, the development of objectives and strategies for the aquatic management plan was driven by the vision for the subbasin (Section 5.1), the current biological and ecological conditions, and the economic and social realities described in the assessment (Section 3.0). Two types of objectives were developed by the aquatic working group, numerical objectives for the number of the number of returning adults of steelhead and salmon and habitat objectives designed to improve limiting factors identified by EDT. EDT was the major methodology used to develop objectives for natural returns and to identify limiting factors from which habitat objectives and strategies were derived. In addition, objectives were developed to address passage barriers in the subbasin, which have received little attention and the impact of which is most likely underestimated by the current EDT outputs. Strategies were also developed by the aquatic working group to improve habitat and to enhance the artificial production programs in the subbasin.

5.3.2 Aquatic Objectives and Strategies

The aquatic working group developed a set of 16 qualitative management objectives that are used to guide more specific, quantitative objectives and strategies. These qualitative management objectives are:

Population and Environmental Status

1: Monitor the status and trends of fish and mussel populations, their habitats and ecosystems throughout the Umatilla Basin.

Natural Production

2: Maintain and enhance natural production, productivity, abundance, life history characteristics and genetic diversity of fish and mussels throughout the Umatilla Basin using habitat protection and improvement.

3: Maintain, augment, and enhance natural production, productivity, abundance, life history characteristics and genetic diversity of steelhead, Chinook, coho, and lamprey throughout the Umatilla Basin using hatchery supplementation and out-planting

4: Maintain the Birch Creek sub-population as a natural steelhead sanctuary (not supplemented).

5: Restore and maintain diverse and productive natural populations of Chinook and coho in the Umatilla Subbasin using hatchery reintroductions.

Hatchery Program

6: Develop and maintain a local brood source for steelhead and Chinook from returns to the Umatilla River.

7: Operate hatchery program to achieve subbasin smolt production, smolt to adult return, and hatchery adult return goals from the subbasin plan.

8: Achieve optimal effectiveness in the operation of the Umatilla Basin steelhead and Chinook hatchery programs while meeting production, population, and conservation objectives for natural- and hatchery-reared fishes.

9: Minimize any negative impacts of the Umatilla Basin hatchery program on natural steelhead and Chinook, and non-target populations.

Flow and Passage

10: Maintain and enhance flow for homing and passage of steelhead and Chinook through the lower Umatilla River using flow restoration and enhancement.

11: Maintain and enhance steelhead and Chinook rearing and spawning habitat in the mainstem Umatilla River with flow enhancement and protection.

12: Maintain and enhance passage of adult and juvenile steelhead and Chinook throughout the Umatilla Subbasin with passage protection and restoration.

Fisheries

13: Maintain and enhance tribal and non-tribal steelhead, Chinook, coho and lamprey fisheries compatible with production, population, and conservation objectives.

Collaboration and Communication

14: Maximize effectiveness of Umatilla Subbasin RM&E projects with collaborative study planning and implementation, synthesis of results, and results dissemination.

15: Maximize management effectiveness of Umatilla Basin fish programs using local and regional protocols in RM&E methodologies that allow exchange of compatible information among local and regional databases and fisheries management entities.

16: Maximize our understanding of the impacts of out-of-basin factors on Umatilla smolt-to-adult survival with collaborative assessments, surveys, tagging, data analysis, modeling, and results dissemination.

In addition to these qualitative management objectives, the aquatic working group also developed numeric population goals for returning adults of steelhead and salmon. These numeric goals include natural returns, hatchery returns, and harvest goals (Table 2). The potential natural production of each species (except coho) expected from the implementation of the management plan is listed as natural return objectives. The current EDT model predicts no sustainable natural production of coho based on the implementation of the habitat restoration plan so a value of ½ PFC was used instead. These expected natural production objectives assume the implementation of all habitat restoration actions including the Phase III flow enhancement project, and the maintenance of Phase I and II flow enhancement projects. Although many habitat actions are included in the management plan, it is the implementation of these flow restoration activities that provide the greatest fish benefits within a 15-year time period (the work projection period of this plan).

Other adult return objectives from past planning efforts are also included in Table 2. Since this plan is a culmination of numerous planning efforts, it is important to recognize anadromous fish objectives from previous planning documents.

Table 2. Comparison of anadromous fish objectives from various plans & processes

Species	Source Plan[1/]	Tot. Return Objective	Natural Returns	Hatchery Returns	Harvest Component
Spring Chinook	1987 USvOR	2,030	870	1,160	-
	1990 SBP	11,000	1,000	10,000	8,800
	1996 TRP	11,000	1,000	10,000	8,800
	2001 SBS	8,000	3,000	6,000	4,000
	2004 EDT	-	1,702	-	-
Fall Chinook	1990 SBP	21,000	11,000	10,000	5,400
	1996 TRP	21,000	11,000	10,000	5,400
	2001 SBS	12,000	6,000	6,000	5,000
	2004 EDT	-	4,192	-	-
Coho	1990 SBP	6,000	-	6,000	-
	1996 TRP	6,000	-	6,000	-
	2001 SBS	6,000	-	6,000	-
	2004 EDT	-	1,568	-	-
Steelhead	1987 USvOR	7,958	4,300	3,658	-
	1990 SBP	9,670	4,000	5,670	5,460
	1996 TRP	9,670	4,000	5,670	5,460
	2001 SBS	5,500	4,000	1,500	1,384
	2004 EDT	-	3,610	-	-

1/ Sources of spring chinook and steelhead return objectives are as follows:
USvOR = 1987 United States vs Oregon Subbasin Production Reports; SBP = 1990 NPPC Subbasin Plan; TRP = 1996 CRITFC Spirit of the Salmon (Tribal Restoration Plan); SBS = 2001 NPPC Subbasin Summary; EDT natural production estimates were derived from the PFC analysis in this this plan in Section 3.6.1.2. Total return objectives using the EDT tool are under development by fisheries managers.

5.3.2.1 Natural Production Objectives and Strategies

EDT was the tool used to define the numeric objectives for natural returns shown in table 2. As stated above, to achieve these numerical objectives will require the restoration of all priority geographic areas as well as the implementation of Phase III of the Umatilla Basin Project. As shown in Section 3.6.1.1 of the Assessment, this restoration scenario produces the largest returns of all the anadromous species. On May 21, 2004 the aquatic working group developed a series of strategies designed to achieve these numeric objectives. In addition, the group developed habitat objectives for each of the priority geographic areas (as identified by EDT) and identified which strategies would work to achieve those objectives. The aquatic working group also developed a series of qualitative artificial production objectives for each geographic area. However, more quantitative objectives and strategies are listed below under the subheading *Artificial Production Objectives and Strategies.* Finally, bull trout were incorporated into this area by area analysis. This was done to provide continuity in the plan and is defensible because many of the limiting factors impacting the anadromous focal species also are limiting to bull trout and thus the same habitat objectives and strategies will work for all of these species.

The management strategies to enhance natural production through habitat restoration in order of priority are:

1) **Maintenance of Phase I and II, and implementation of Phase III Umatilla Basin Projects**. The Umatilla Basin Project is outlined in Section 3.1.3.2. Under one possible scenario of Phase III, summer flows in the Umatilla River will be enhanced (and water temperatures decreased) from Thornhollow Springs (RM 73.5) to the mouth. Thus, implementation of Phase III will impact flow and temperature in GAs 28, 25, 11, 9, 2, and 1.
2) **Purchase water rights from willing sellers.** Purchased water rights can come from water directly removed from the Umatilla or Willow mainstems and tributaries or from McKay and/or Willow Creek reservoirs. This water can then be left instream or released from McKay or Willow Creek reservoirs to enhance flows and decrease temperatures.
3) **Increase water conservation and irrigation efficiency.** This strategy will aid in improving streamflow by reducing the quantity of water withdrawn for agricultural, industrial or municipal purposes. Typical conservation projects include conversion of flood irrigation systems to sprinklers, piping and lining of irrigation ditch systems, decreased watering of lawns by municipalities, etc.
4) **Modify zoning and flood control planning through regulatory actions.** By working to improve zoning ordinances to prevent development of riparian areas and floodplains, better riparian function and channel-floodplain connection can be attained and/or maintained.
5) **Place large woody debris and large boulders.** Where opportunities exist, work on public, federal, state, tribal and private lands will be conducted to improve instream habitat. Placing large woody debris and large boulders directly increases habitat complexity and can improve habitat quantity by increasing the number of pools.
6) **Fence and plant riparian zones.** Where opportunities exist, work on public, federal, state, tribal and private lands will be conducted to improve riparian habitat. Fencing is installed to manage use of the riparian zone by livestock and planting of native vegetation is done to speed the recovery process once grazing or other land uses have been modified. Riparian habitat improvements can directly impact stream temperatures and sediment inputs (through stabilizing streambanks and filtering runoff).
7) **Modify channel and flood-plain function**. Where opportunities exist, work on public, federal, state, tribal and private lands will be conducted to improve form and function of stream channels. This work involves directly or indirectly returning stream channels to a functional state that is determined by the valley

form, geology, soils, vegetation and climate. Specific parameters often targeted by this type of work include channel width and depth, sinuosity, slope, flood prone area, ratio of channel features, etc.

8) **Construct pool and riffle habitat using in-stream modifications**. Where opportunities exist, work on public, federal, state, tribal and private lands will be conducted to increase the quantity of pools and gravel dominated riffles (as opposed to cobble). Straightening and entrenchment of stream channels as is a common problem in the Umatilla Basin that leads to the reduction of pool habitat and gravel dominated riffles. Pools will be constructed by direct intervention, often concurrently with work to restore channel form a function, and the quantity of gravel dominated riffles will be improved by decreasing channel slope, reducing entrenchment and confinement, and restoring pool/riffle sequencing.
9) **Maintain, relocate, or eliminate forest, public and private roads in riparian and sensitive areas**. Where opportunities exist, work on public, federal, state, tribal and private lands will be conducted to address problems caused by roads. Roads are a source of sediment and a means of rapidly routing sediment to streams, occupy historic riparian zones, and often result in stream confinement. Maintenance, relocation or removal of roads are the primary tools for addressing the problems.
10) **Increase protective status of priority habitats**. Where habitats have high value due to their current productive capacity or general importance to particular species, they should be protected to maintain their value. This can be accomplished by easements and other kinds of natural resource protection agreements, or on public lands by varying kinds of protections authorized by statute or rule.
11) **Modify detrimental land use activities**. Change land use activities leading to degradation of habitat, thereby allowing stream attributes impacted by these activities to recover without intervention. A common example of this kind of work is riparian buffers where streamside areas are protected from uses such as livestock grazing or agricultural crops.
12) **Restore upstream or headwater attributes to improve downstream conditions**. In particular, water quality problems are cumulative in a downstream direction. Sources of water quality problems at a particular location can often be sourced to areas upstream. This is also true of large wood debris. The source of large wood debris for some reaches can be primarily from upstream reaches. Limiting factors such as fine sediment, water temperature and large wood debris should be addressed at the watershed scale as well as the reach/geographic area scale. Understanding of these problems at the watershed scale is necessary, however, to effectively work at this scale. Actions such as restoration of riparian vegetation and channel function upstream of areas limited by temperature, sediment and/or large wood should be particularly effective.
13) **Increase passage efficiency of in-stream obstructions including culverts, bridges, diversion structures, and unscreened diversions.** Correction of passage deficiencies should be corrected wherever they exist. Table __ is a list of known passage problems.

14) **Maintain passage efficiency through ongoing O&M activities**. Structural fixes installed to provide fish passage over irrigation dams, etc. require maintenance to operate within design criteria. All fish passage facilities should be maintained to provide optimal passage conditions.

These strategies were determined to generally be of three types: those that address ongoing causative factors, those that restore natural processes, and those that artificially enhance natural processes. Many of the strategies fit more than one of these types and many strategies address several limiting factors. The limiting factors and the types of strategies are shown in table 3.

Table 3. Management strategies (by number) and their general type and the limiting factors they address.

Limiting Factor ➔	**Habitat Quantity**	**Habitat Diversity**	**Channel Stability**	**Sediment**	**Low Flow**	**High Temper-ature**	**Passage**
Address Ongoing Causative Factors	1,2,3,4,6, 10,11	4,6,9,10,11	4,6,9,10, 11	4,6,9,10, 11	1,2,3, 4,10, 11	1,2,3,4, 10,11	1,2,3, 13,14
Restore Natural Processes	2,3,4,6,7,9, 10,11,12, 13	4,6,7,9,10, 11,12	4,7,9,10, 11,12	4,6,7,9, 10,11,12	2,3,4, 6,7, 10,11, 12	2,3,4,6,7, 10,11,12	2,3,7, 12,13, 14
Artificially Enhance Natural Processes	1,5,6,7,8	5,6,7,8	5,6,7,8	5,6,7,8	1,6,7	1,5,6,7,8	1,7,13, 14

These strategies will be implemented to achieve the numeric objectives shown in Table 2. These objectives are based upon habitat restoration of all priority geographic areas and implementation of Phase III.

Based on the EDT results, the aquatic working group determined that the important limiting factors could be addressed through habitat restoration and implementation of Phase III of the Umatilla Basin Project. Implementation of Phase III will involve increased instream flows in the mainstem from Thornhollow (RM 73.5) to the mouth and will impact GAs 1, 2, 9, 11, 25, and 28. Each of these actions should result in lower water temperatures, increased passage survival, and increased habitat quantity. Habitat restoration (based on specific habitat objectives and strategies that are outlined in the Management Plan) should also address sediment loads and habitat complexity. From this, three restoration scenarios were examined with EDT:

1) Habitat restoration of the top priority geographic areas singly plus the implementation of Phase III of the Umatilla Basin Project.
2) Habitat restoration of the top 19 geographic areas plus implementation of Phase III.

3) Habitat restoration of the top 19 geographic areas with no implementation of Phase III.

The impact of each of these scenarios on the anadromous focal species was determined through EDT. EDT output provides a working hypothesis on the impact that each scenario has on the productivity and abundance of steelhead and salmon. While the results of the three scenarios are given below, the aquatic working group has adopted scenario 2 as its primary scenario and the on that the numeric goals in Table 2 are base upon. The following is the results of the EDT runs based on the three scenarios.

Working Hypotheses

***Steelhead* –** EDT estimate of current abundance = 2,650 adults and productivity = 4.9

1) Restoration of the top priority geographic area (the area ranked 1) plus the implementation of Phase III will result in no impact on productivity and an increase in returning adult abundance by approximately 2% (adult abundance = 2,705).

2) Restoration of the top 19 priority geographic areas plus implementation of Phase III will result in an increase of productivity by 43% (a value of 7.0) and an increase in returning adult abundance by approximately 36% (an abundance of 3,610 adults).

3) Restoration of the top 19 priority geographic areas with no Phase III will result in an increase in productivity by 37% (a value of 6.7) and an increase in returning adult abundance by approximately 30% (an abundance of 3,443 adults).

These results are shown graphically in figures 2 and 3.

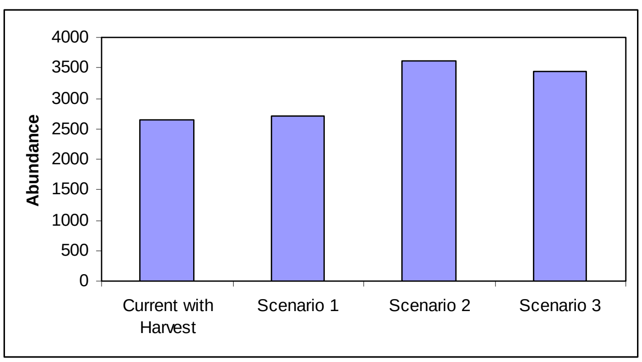

Figure 1. EDT estimate of current abundance and results showing the impacts on abundance of adult steelhead under the three restoration scenarios.

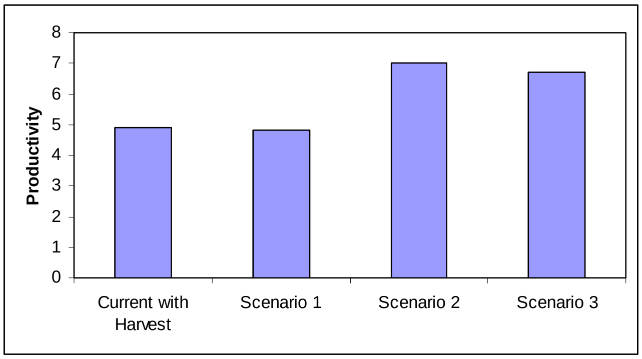

Figure 3. EDT estimate of current productivity and results showing the impacts on productivity of the steelhead population under the three restoration scenarios.

Spring Chinook – EDT estimate of current abundance = 440 adults and productivity= 2.3

1) Restoration of the top priority geographic area (the area ranked 1) plus the implementation of Phase III will result in an increase in productivity by 42% (a value of 3.4) and an increase in returning adult abundance by approximately 152% (adult abundance = 1,108).

2) Restoration of the top 19 priority geographic areas plus implementation of Phase III will result in an increase of productivity by 100% (a value of 4.6) and an increase in returning adult abundance by approximately 287% (an abundance of 1,702 adults).

3) Restoration of the top 19 priority geographic areas with no Phase III will result in an increase in productivity by 83% (a value of 4.2) and an increase in abundance of returning adults by approximately 127% (an abundance of 998 adults).

These results are shown graphically in figures 4 and 5.

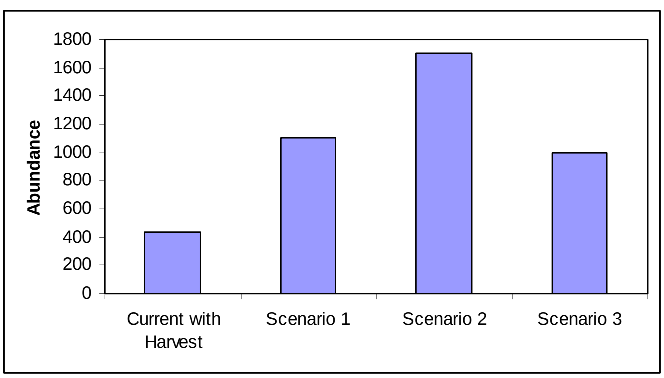

Figure 4. EDT estimate of current abundance and results showing the impacts on abundance of adult spring Chinook under the three restoration scenarios.

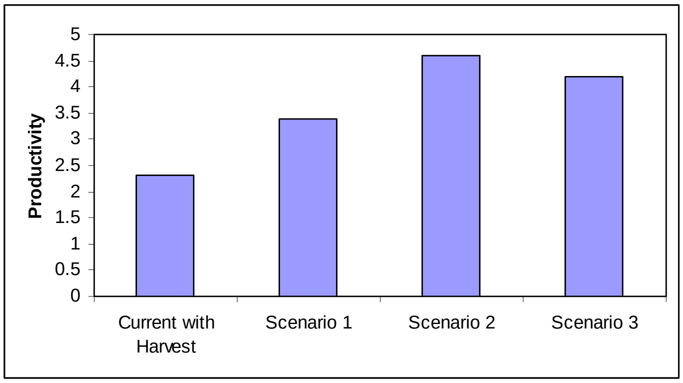

Figure 5. EDT estimate of current productivity and results showing the impacts on productivity of the spring Chinook population under the three restoration scenarios.

***Fall Chinook* –** EDT estimate of current abundance = 0 adults and productivity = 0.4

1) Restoration of the top priority geographic area (the area ranked 1) plus the implementation of Phase III will result in an increase in productivity by 200% (a value of 1.2) and an increase in returning adult abundance to approximately 1,457 fish.

2) Restoration of the top 19 priority geographic areas plus implementation of Phase III will result in an increase of productivity by 350% (a value of 1.8) and an increase in returning adult abundance to approximately 4,192 fish.

3) Restoration of the top 19 priority geographic areas with no Phase III will result in an increase in productivity by 275% (a value of 1.5) and an increase in abundance of returning adults to approximately 3,005 fish.

These results are shown graphically in figures 6 and 7.

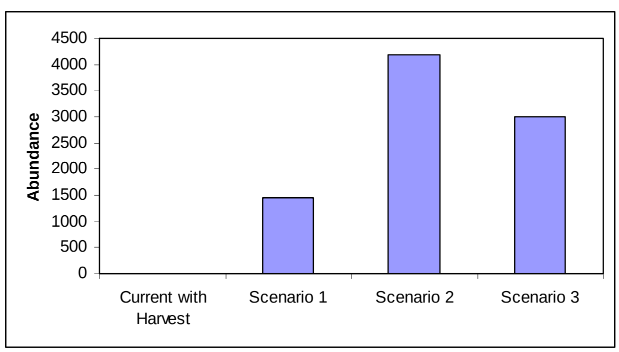

Figure 6. EDT estimate of current abundance and results showing the impacts on abundance of adult fall Chinook under the three restoration scenarios.

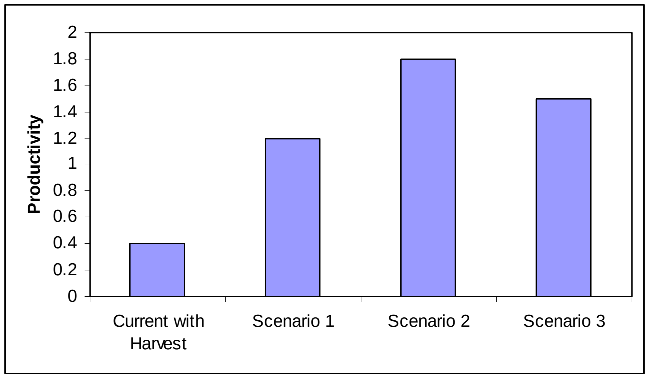

Figure 7. EDT estimate of current productivity and results showing the impacts on productivity of the fall Chinook population under the three restoration scenarios.

Coho – EDT estimate of current abundance = 0 adults and productivity = 0.4

1) Restoration of the top priority geographic area (the area ranked 1) plus the implementation of Phase III will result in an increase in productivity by 25% (a value of 0.5); however, the number of adult returns will continue to be so small as to be negligible (i.e., recognized as 0 by EDT).

2) Restoration of the top 19 priority geographic areas plus implementation of Phase III will result in an increase of productivity by 150% (a value of 1.0) and an increase in returning adult abundance to approximately 69 fish.

3) Restoration of the top 19 priority geographic areas with no Phase III will result in an increase in productivity by 125% (a value of 0.9); however, the number of adult returns will continue to be so small as to be negligible (i.e., recognized as 0 by EDT).

These results are shown graphically in figures 8 and 9.

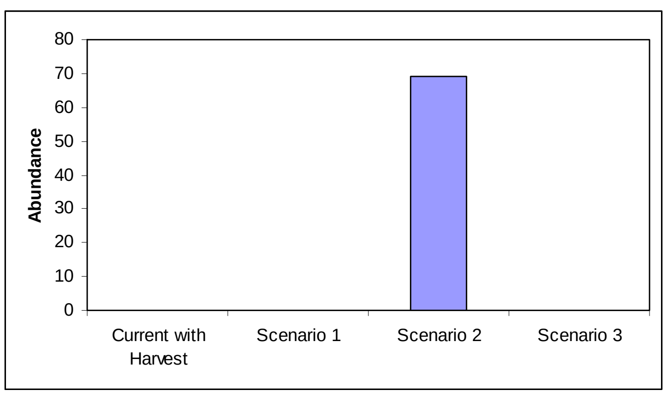

Figure 8. EDT estimate of current abundance and results showing the impacts on abundance of adult coho under the three restoration scenarios.

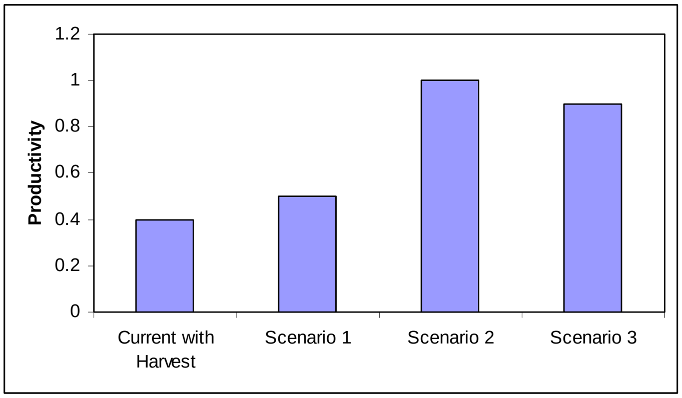

Figure 9. EDT estimate of current productivity and results showing the impacts on productivity of the coho population under the three restoration scenarios.

EDT runs were also conducted for each priority geographic area separately (these runs assume the implementation of Phase III). For each priority geographic area specific habitat objectives are listed. In addition, the management strategies that pertain specifically to a geographic area and its habitat objectives are also shown.

Priority Geographic Area: GA2, Umatilla River, Threemile Dam to Butter Creek

Priority Fish Species and Life Stages: Steelhead, Spring Chinook, and Fall Chinook

Limiting Factors: sediment, water temperature, obstruction, channel stability, flow, habitat quantity and habitat diversity.

Priority Ranking:

Species	Steelhead	Spring Chinook	Fall Chinook	Coho	Bull Trout
Protection Ranking	12	11	LP	LP	LP
Restoration Ranking	LP	7	3	LP	LP

(LP = low priority)

Quantitative Habitat Objectives: 25% restoration of fine sediment, 50% restoration of water temperatures, 25% restoration of confinement, 25% restoration of maximum width, and 100% restoration of flow.

Qualitative Artificial Production Objectives: Enhance migration of released hatchery smolts and returning adults for all species. Increase fall Chinook spawning and enhance rearing habitat for juveniles.

Working Hypothesis: The implementation of the quantitative habitat objectives and phase III will result in increases in productivity for:

Steelhead – no increase
Spring Chinook – no increase
Fall Chinook – no increase
Coho – no increase.

And increases in abundance of returning adults:

Steelhead – from 2,650 to 2,668
Spring Chinook – from 498 to 506
Fall Chinook – from 0 to 355
Coho – no increase

Management Strategies in Order of Priority (strategies in bold are chosen for this GA):

1) **Maintenance of Phase I and II, and implementation of Phase III Umatilla Basin Projects.**
2) Purchase water rights from willing sellers.
3) Increase water conservation and irrigation efficiency.
4) **Modify zoning and flood control planning**. *Regulatory actions*
5) Place large woody debris and large boulders.
6) **Fence and plant riparian zones**.
7) **Modify channel and flood-plain function.**
8) Construct pool and riffle habitat using in-stream modifications.
9) Maintain, relocate, or eliminate forest, public and private roads in riparian and sensitive areas.
10) **Increase protective status of priority habitats.**
11) **Modify detrimental land use activities.** *Volunteer through PR and education*
12) **Restore upstream or headwater attributes to improve downstream conditions.**
13) Increase passage efficiency of in-stream obstructions including culverts, bridges, diversion structures, and unscreened diversions.
14) **Maintain passage efficiency through ongoing O&M activities**.

Priority Geographic Area: GA9, Umatilla River between Butter Creek and Westland Dam

Priority Fish Species and Life Stages: Coho**,** Spring Chinook, and Fall Chinook

Limiting Factors: sediment, water temperature, channel stability, habitat diversity, and flow.

Priority Ranking:

Species	Steelhead	Spring Chinook	Fall Chinook	Coho	Bull Trout
Protection Ranking	LP	5	HP	HP	LP
Restoration Ranking	LP	6	1	1	LP

(LP = low priority) (HP=high priority due to restoration ranking)

Quantitative Habitat Objectives: 25% restoration of fine sediment, 50% restoration of water temperatures, 25% reduction in bed scour, 25% restoration of confinement, 25% restoration of maximum width, 25% restoration of large wood, and 100% restoration of flow.

Qualitative Artificial Production Objectives: Enhance migration of released hatchery smolts and returning adults for all species. Increase fall Chinook and coho spawning and enhance rearing habitat for juveniles.

Working Hypothesis: The implementation of the quantitative habitat objectives and Phase III will result in increases in productivity for:

Steelhead – no increase
Spring Chinook – no increase
Fall Chinook – an increase from 1.0 to 1.2
Coho – an increase from 0.4 to 0.5

And an increase in abundance for:

Steelhead – from 2,650 to 2,667
Spring Chinook – from 498 to 529
Fall Chinook – from 0 to 1,457
Coho – no increase

Management Strategies in Order of Priority (strategies in bold were chosen for this GA):

1) **Maintenance of Phase I and II, and implementation of Phase III Umatilla Basin Projects.**
2) Purchase water rights from willing sellers.
3) **Increase water conservation and irrigation efficiency.**
4) **Modify zoning and flood control planning**. *Regulatory actions*
5) **Place large woody debris and large boulders.**
6) **Fence and plant riparian zones**.
7) **Modify channel and flood-plain function.**
8) Construct pool and riffle habitat using in-stream modifications.

9) Maintain, relocate, or eliminate forest, public and private roads in riparian and sensitive areas.
10) Increase protective status of priority habitats.
11) **Modify detrimental land use activities.** *Volunteer through PR and education*
12) Restore upstream or headwater attributes to improve downstream conditions.
13) Increase passage efficiency of in-stream obstructions including culverts, bridges, diversion structures, and unscreened diversions.
14) **Maintain passage efficiency through ongoing O&M activities**.

Priority Geographic Area: GA25, Umatilla River between McKay Creek and Mission Bridge

Priority Fish Species and Life Stages: Coho**,** Spring Chinook, and Fall Chinook

Limiting Factors: water temperature, sediment, habitat diversity, channel stability, and flow.

Priority Ranking:

Species	Steelhead	Spring Chinook	Fall Chinook	Coho	Bull Trout
Protection Ranking	LP	10	6	HP	LP
Restoration Ranking	LP	4	LP	3	LP

(LP = low priority) (HP=high priority due to restoration ranking)

Quantitative Habitat Objectives: 50% restoration of water temperatures, 25% restoration of fine sediment, 25% restoration of large wood, 25% reduction in bed scour, 25% restoration of confinement, 25% restoration of maximum width, and 100% restoration of flow.

Qualitative Artificial Production Objectives: Enhance migration of released hatchery smolts and returning adults for all species. Increase fall Chinook and coho spawning and enhance rearing habitat for juveniles. Continue acclimation and release of steelhead and coho salmon.

Working Hypothesis: The implementation of the quantitative habitat objectives and Phase III will increases in productivity for:

Steelhead – no increase
Spring Chinook – no increase
Fall Chinook – no increase
Coho – no increase

And increases in abundance for:

Steelhead – no increase
Spring Chinook – from 498 to 509
Fall Chinook – no increase
Coho – no increase

Management Strategies in Order of Priority (strategies in bold have been chosen for this GA):

1) **Maintenance of Phase I and II, and implementation of Phase III Umatilla Basin Projects.**
2) Purchase water rights from willing sellers.
3) Increase water conservation and irrigation efficiency.
4) **Modify zoning and flood control planning**. *Regulatory actions*
5) **Place large woody debris and large boulders.**
6) **Fence and plant riparian zones**.
7) **Modify channel and flood-plain function.**
8) Construct pool and riffle habitat using in-stream modifications.
9) Maintain, relocate, or eliminate forest, public and private roads in riparian and sensitive areas.
10) **Increase protective status of priority habitats.**
11) **Modify detrimental land use activities.** *Volunteer through PR and education*
12) **Restore upstream or headwater attributes to improve downstream conditions.**
13) Increase passage efficiency of in-stream obstructions including culverts, bridges, diversion structures, and unscreened diversions.
14) Maintain passage efficiency through ongoing O&M activities.

Priority Geographic Area: GA28, Umatilla River between Mission Bridge and Meacham Creek

Priority Fish Species and Life Stages: Steelhead Coho**,** Spring Chinook, fall Chinook, and Bull trout

Limiting Factors: water temperature, sediment, and habitat quantity.

Priority Ranking:

Species	Steelhead	Spring Chinook	Fall Chinook	Coho	Bull Trout
Protection Ranking	HP	7	2	HP	HP*
Restoration Ranking	2	1	2	2	HP*

(LP = low priority) (HP=high priority due to restoration ranking) (HP*=high priority as per QHA)

Quantitative Habitat Objectives: 50% restoration of water temperatures, 25% restoration of fine sediment, 50% increase in pools, 25% restoration of large wood.

Qualitative Artificial Production Objectives: Enhance migration and rearing of all hatchery species. Increase steelhead, spring Chinook, fall Chinook and coho spawning. Continue acclimation and release of fall Chinook and steelhead.

Working Hypothesis: The implementation of the quantitative habitat objectives and Phase III will result in increases in productivity for:

Steelhead – from 4.9 to 5.3
Spring Chinook – from 2.4 to 3.4
Fall Chinook – from 1.0 to 1.3
Coho – from 0.4 to 0.7

And increases in abundance for:

Steelhead – from 2,650 to 2,958
Spring Chinook – from 498 to 1,108
Fall Chinook – from 0 to 1,887
Coho – no increase

Management Strategies in Order of Priority (strategies in bold were chosen for this GA):

1) **Maintenance of Phase I and II, and implementation of Phase III Umatilla Basin Projects.**
2) Purchase water rights from willing sellers.
3) Increase water conservation and irrigation efficiency.
4) **Modify zoning and flood control planning**. *Regulatory actions*
5) **Place large woody debris and large boulders.**
6) **Fence and plant riparian zones**.
7) **Modify channel and flood-plain function.**
8) **Construct pool and riffle habitat using in-stream modifications.**
9) Maintain, relocate, or eliminate forest, public and private roads in riparian and sensitive areas.
10) **Increase protective status of priority habitats.**
11) **Modify detrimental land use activities.** *Volunteer through PR and education*
12) **Restore upstream or headwater attributes to improve downstream conditions.**
13) Increase passage efficiency of in-stream obstructions including culverts, bridges, diversion structures, and unscreened diversions.
14) Maintain passage efficiency through ongoing O&M activities

Priority Geographic Area: GA40, Umatilla River between Meacham Creek and the Forks.

Priority Fish Species and Life Stages: Steelhead**,** Coho**,** spring Chinook, fall Chinook, and Bull trout

Limiting Factors: water temperature, habitat diversity, and habitat quantity.

Priority Ranking:

Species	Steelhead	Spring Chinook	Fall Chinook	Coho	Bull Trout
Protection Ranking	2	1	1	1	HP*
Restoration Ranking	3	3	LP	7	HP*

(LP = low priority) (HP=high priority due to restoration ranking) (HP*=high priority as per QHA)

Quantitative Habitat Objectives: 50% restoration of water temperatures, 75% restoration of large wood, 75% increase in pools.

Qualitative Artificial Production Objectives: Enhance migration and rearing of all hatchery species. Increase steelhead, spring Chinook, fall Chinook and coho spawning. Continue acclimation and release of spring Chinook.

Working Hypothesis: The implementation of the quantitative habitat objectives and Phase III will result in increases in productivity for:

Steelhead – from 4.9 to 5.1
Spring Chinook – from 2.4 to 3.2
Fall Chinook – no increase
Coho – from 0.4 to 0.6

And increases in abundance from:

Steelhead – 2,650 to 2,702
Spring Chinook – from 498 to 645
Fall Chinook – from 0 to 173
Coho – no increase

Management Strategies in Order of Priority (strategies in bold were chosen for this GA):

1) Maintenance of Phase I and II, and implementation of Phase III Umatilla Basin Projects.
2) Purchase water rights from willing sellers.
3) Increase water conservation and irrigation efficiency.
4) **Modify zoning and flood control planning**. *Regulatory actions*
5) **Place large woody debris and large boulders.**

6) **Fence and plant riparian zones**.
7) **Modify channel and flood-plain function.**
8) **Construct pool and riffle habitat using in-stream modifications.**
9) **Maintain, relocate, or eliminate forest, public and private roads in riparian and sensitive areas.**
10) **Increase protective status of priority habitats.**
11) **Modify detrimental land use activities.** *Volunteer through PR and education*
12) **Restore upstream or headwater attributes to improve downstream conditions.**
13) Increase passage efficiency of in-stream obstructions including culverts, bridges, diversion structures, and unscreened diversions.
14) Maintain passage efficiency through ongoing O&M activities.

Priority Geographic Area: GA43, South Fork Umatilla from mouth to Thomas Creek.

Priority Fish Species and Life Stages: Spring Chinook

Limiting Factors: habitat diversity and **channel stability**. Professional judgement of managers is that water temperature is also a limiting factor in this geographic area and thus management strategies will acknowledge this additional limiting factor.

Priority Ranking:

Species	Steelhead	Spring Chinook	Fall Chinook	Coho	Bull Trout
Protection Ranking		4			
Restoration Ranking		9			

(LP = low priority) (HP=high priority due to restoration ranking) (HP*=high priority as per QHA)

Quantitative Habitat Objectives: 75% restoration of large wood, 100% restoration of confinement, 50% restoration of bankfull width, 50% restoration of bed scour, and 50% restoration of water temperature.

Qualitative Artificial Production Objectives: Continue spring Chinook hatchery program to restore production in the improved GA.

Working Hypothesis: The implementation of the quantitative habitat objectives and Phase III will result in increased productivity for:

Spring Chinook – from 2.4 to 2.6

And increased abundance for:

Spring Chinook – from 498 to 523

Management Strategies in Order of Priority (strategies in bold were chosen for this GA):

1) Maintenance of Phase I and II, and implementation of Phase III Umatilla Basin Projects.
2) Purchase water rights from willing sellers.
3) Increase water conservation and irrigation efficiency.
4) Modify zoning and flood control planning. *Regulatory actions*
5) **Place large woody debris and large boulders.**
6) **Fence and plant riparian zones**.
7) Modify channel and flood-plain function.
8) Construct pool and riffle habitat using in-stream modifications.
9) **Maintain, relocate, or eliminate forest, public and private roads in riparian and sensitive areas.**
10) **Increase protective status of priority habitats.**
11) **Modify detrimental land use activities.** *Volunteer through PR and education*
12) **Restore upstream or headwater attributes to improve downstream conditions.**
13) Increase passage efficiency of in-stream obstructions including culverts, bridges, diversion structures, and unscreened diversions.
14) Maintain passage efficiency through ongoing O&M activities.

Priority Geographic Area: GA33, Meacham Creek from the mouth to the North Fork.

Priority Fish Species and Life Stages: Steelhead, spring Chinook, fall Chinook, Coho, and Bull trout

Limiting Factors: water temperature, habitat quantity and habitat diversity.

Priority Ranking:

Species	Steelhead	Spring Chinook	Fall Chinook	Coho	Bull Trout
Protection Ranking	HP	3	3	HP	HP*
Restoration Ranking	4	2	Not listed	5	HP*

(LP = low priority) (HP=high priority due to restoration ranking) (HP*=high priority as per QHA)

Quantitative Habitat Objectives: 33% restoration of water temperature, 50% restoration of large wood, 50% restoration of pools.

Qualitative Artificial Production Objectives: Continue steelhead and spring Chinook hatchery programs to restore production in the improved GA.

Working Hypothesis: The implementation of the quantitative habitat objectives and Phase III will result in increases in productivity for:

Steelhead – no increase
Spring Chinook – from 2.4 to 3.2
Coho – 0.4 to 0.6

And increases in abundance for:

Steelhead – from 2,650 to 2,702
Spring Chinook – from 498 to 648
Coho – no increase

Management Strategies in Order of Priority (strategies in bold were chosen for this GA):

1) Maintenance of Phase I and II, and implementation of Phase III Umatilla Basin Projects.
2) Purchase water rights from willing sellers.
3) Increase water conservation and irrigation efficiency.
4) **Modify zoning and flood control planning**. *Regulatory actions*
5) **Place large woody debris and large boulders.**
6) **Fence and plant riparian zones**.
7) **Modify channel and flood-plain function**.
8) **Construct pool and riffle habitat using in-stream modifications.**
9) **Maintain, relocate, or eliminate forest, public and private roads in riparian and sensitive areas.**
10) **Increase protective status of priority habitats.**
11) **Modify detrimental land use activities.** *Volunteer through PR and education*
12) **Restore upstream or headwater attributes to improve downstream conditions.**
13) Increase passage efficiency of in-stream obstructions including culverts, bridges, diversion structures, and unscreened diversions.
14) Maintain passage efficiency through ongoing O&M activities.

Priority Geographic Area: GA35, North Fork Meacham Creek and tributaries.

Priority Fish Species and Life Stages: Steelhead and spring Chinook

Limiting Factors: water temperature, habitat diversity, and habitat quantity.

Priority Ranking:

Species	Steelhead	Spring Chinook	Fall Chinook	Coho	Bull Trout
Protection Ranking	4	2	Not present	Not present	LP
Restoration Ranking	8	5	Not present	Not present	LP

(LP = low priority) (HP=high priority due to restoration ranking) (HP*=high priority as per QHA)

Quantitative Habitat Objectives: 75% restoration of water temperature, 75% restoration of large wood, 75% restoration of pools.

Qualitative Artificial Production Objectives: Continue steelhead and spring Chinook hatchery programs to restore production in the improved GA.

Working Hypothesis: The implementation of the quantitative habitat objectives and Phase III will result in increases in productivity for:

Steelhead – from 4.9 to 5.1
Spring Chinook – from 2.4 to 2.8

And increases in abundance for:

Steelhead – from 2,650 to 2,693
Spring Chinook – from 498 to 557

Management Strategies in Order of Priority (strategies in bold were chosen for this GA):

1) Maintenance of Phase I and II, and implementation of Phase III Umatilla Basin Projects.
2) Purchase water rights from willing sellers.
3) Increase water conservation and irrigation efficiency.
4) Modify zoning and flood control planning. *Regulatory actions*
5) **Place large woody debris and large boulders.**
6) **Fence and plant riparian zones**.
7) Modify channel and flood-plain function.
8) **Construct pool and riffle habitat using in-stream modifications.**
9) **Maintain, relocate, or eliminate forest, public and private roads in riparian and sensitive areas.**
10) **Increase protective status of priority habitats.**
11) **Modify detrimental land use activities.** *Volunteer through PR and education*
12) Restore upstream or headwater attributes to improve downstream conditions.
13) Increase passage efficiency of in-stream obstructions including culverts, bridges, diversion structures, and unscreened diversions.
14) Maintain passage efficiency through ongoing O&M activities.

Priority Geographic Area: GA38, Meacham Creek from Sheep Creek to headwaters including Two-mile Creek.

Priority Fish Species and Life Stages: Steelhead

Limiting Factors: sediment and habitat diversity.

Priority Ranking:

Species	Steelhead	Spring Chinook	Fall Chinook	Coho	Bull Trout
Protection Ranking	HP	Not present	Not present	Not present	Not present
Restoration Ranking	15	Not present	Not present	Not present	Not present

(LP = low priority) (HP=high priority due to restoration ranking) (HP*=high priority as per QHA)

Quantitative Habitat Objectives: 50% restoration of fine sediment and 75% restoration of large wood.

Qualitative Artificial Production Objectives: Continue steelhead hatchery program to restore production in the improved GA.

Working Hypothesis: The implementation of the quantitative habitat objectives and Phase III will result in increased productivity for:

Steelhead – no increase

And increased abundance for:

Steelhead – no increase

Management Strategies in Order of Priority (strategies in bold were chosen for this GA):

1) Maintenance of Phase I and II, and implementation of Phase III Umatilla Basin Projects.
2) Purchase water rights from willing sellers.
3) Increase water conservation and irrigation efficiency.
4) Modify zoning and flood control planning. *Regulatory actions*
5) **Place large woody debris and large boulders.**
6) **Fence and plant riparian zones**.
7) Modify channel and flood-plain function.
8) Construct pool and riffle habitat using in-stream modifications.
9) **Maintain, relocate, or eliminate forest, public and private roads in riparian and sensitive areas.**
10) **Increase protective status of priority habitats.**
11) **Modify detrimental land use activities.** *Volunteer through PR and education*

12) **Restore upstream or headwater attributes to improve downstream conditions.**
13) Increase passage efficiency of in-stream obstructions including culverts, bridges, diversion structures, and unscreened diversions.
14) Maintain passage efficiency through ongoing O&M activities.

Priority Geographic Area: GA32, Iskuulpa Creek from Bachelor Canyon to headwaters.

Priority Fish Species and Life Stages: Steelhead

Limiting Factors: water temperature, sediment and habitat quantity.

Priority Ranking:

Species	Steelhead	Spring Chinook	Fall Chinook	Coho	Bull Trout
Protection Ranking	HP	Not present	Not present	Not present	Not present
Restoration Ranking	7	Not present	Not present	Not present	Not present

(LP = low priority) (HP=high priority due to restoration ranking) (HP*=high priority as per QHA)

Quantitative Habitat Objectives: 100% restoration of water temperature, 100% restoration of fine sediment, 100% restoration of pools.

Qualitative Artificial Production Objectives: Continue steelhead hatchery program to restore production in the improved GA.

Working Hypothesis: The implementation of the quantitative habitat objectives and Phase III will result in increased productivity for:

Steelhead – from 4.9 to 5.1

And increased abundance for:

Steelhead – from 2,650 to 2,685

Management Strategies in Order of Priority (strategies in bold were chosen for this GA):

1) Maintenance of Phase I and II, and implementation of Phase III Umatilla Basin Projects.
2) Purchase water rights from willing sellers.
3) Increase water conservation and irrigation efficiency.
4) Modify zoning and flood control planning. *Regulatory actions*
5) Place large woody debris and large boulders.

6) **Fence and plant riparian zones**.
7) Modify channel and flood-plain function.
8) Construct pool and riffle habitat using in-stream modifications.
9) **Maintain, relocate, or eliminate forest, public and private roads in riparian and sensitive areas.**
10) **Increase protective status of priority habitats.**
11) **Modify detrimental land use activities.** *Volunteer through PR and education*
12) Restore upstream or headwater attributes to improve downstream conditions.
13) Increase passage efficiency of in-stream obstructions including culverts, bridges, diversion structures, and unscreened diversions.
14) Maintain passage efficiency through ongoing O&M activities.

Priority Geographic Area: GA31, Iskuulpa Creek from mouth to Bachelor Canyon.

Priority Fish Species and Life Stages: Spring Chinook

Limiting Factors: water temperature, sediment, habitat diversity, and habitat quantity.

Priority Ranking:

Species	Steelhead	Spring Chinook	Fall Chinook	Coho	Bull Trout
Protection Ranking	HP[1]	HP	Not present	Not present	LP
Restoration Ranking	LP	8	Not present	Not present	LP

(LP = low priority) (HP=high priority due to restoration ranking) (HP*=high priority as per QHA)
HP[1] based on high steelhead spawning densities, professional judgement suggests that this GA should receive a high priority for protection for steelhead.

Quantitative Habitat Objectives: 100% restoration of water temperature, 100% restoration of fine sediment, 100% restoration of large wood, and 100% restoration of pools.

Qualitative Artificial Production Objectives: Continue spring Chinook and steelhead hatchery programs to restore and maintain production in the improved GA.

Working Hypothesis: The implementation of the quantitative habitat objectives and Phase III will result in increased productivity for:

Spring Chinook – from 2.4 to 2.7

And increased abundance for:

Spring Chinook – from 498 to 540

Management Strategies in Order of Priority (strategies in bold were chosen for this GA):

1) Maintenance of Phase I and II, and implementation of Phase III Umatilla Basin Projects.
2) Purchase water rights from willing sellers.
3) Increase water conservation and irrigation efficiency.
4) **Modify zoning and flood control planning**. *Regulatory actions*
5) **Place large woody debris and large boulders.**
6) **Fence and plant riparian zones**.
7) Modify channel and flood-plain function.
8) **Construct pool and riffle habitat using in-stream modifications**.
9) **Maintain, relocate, or eliminate forest, public and private roads in riparian and sensitive areas.**
10) **Increase protective status of priority habitats.**
11) **Modify detrimental land use activities.** *Volunteer through PR and education*
12) **Restore upstream or headwater attributes to improve downstream conditions**.
13) Increase passage efficiency of in-stream obstructions including culverts, bridges, diversion structures, and unscreened diversions.
14) Maintain passage efficiency through ongoing O&M activities.

Priority Geographic Area: GA12, Birch Creek mouth to forks.

Priority Fish Species and Life Stages: Steelhead

Limiting Factors: water temperature, sediment, habitat quantity, and obstructions.

Priority Ranking:

Species	Steelhead	Spring Chinook	Fall Chinook	Coho	Bull Trout
Protection Ranking	HP	Not present	Not present	LP	Not present
Restoration Ranking	1	Not present	Not present	LP	Not present

(LP = low priority) (HP=high priority due to restoration ranking) (HP*=high priority as per QHA)

Quantitative Habitat Objectives: 25% restoration of water temperature, 25% restoration of fine sediment, 25% restoration of large wood, 50% restoration of pools, 100% resolution of obstructions.

Qualitative Artificial Production Objectives: NA

Working Hypothesis: The implementation of the quantitative habitat objectives and Phase III will result in increased productivity for:

Steelhead – no increase

And increased abundance for:

Steelhead – from 2,650 to 2,705

Management Strategies in Order of Priority (strategies in bold were chosen for this GA):

1) Maintenance of Phase I and II, and implementation of Phase III Umatilla Basin Projects.
2) Purchase water rights from willing sellers.
3) Increase water conservation and irrigation efficiency.
4) **Modify zoning and flood control planning**. *Regulatory actions*
5) **Place large woody debris and large boulders.**
6) **Fence and plant riparian zones**.
7) **Modify channel and flood-plain function**.
8) **Construct pool and riffle habitat using in-stream modifications**.
9) **Maintain, relocate, or eliminate forest, public and private roads in riparian and sensitive areas.**
10) **Increase protective status of priority habitats.**
11) **Modify detrimental land use activities.** *Volunteer through PR and education*
12) **Restore upstream or headwater attributes to improve downstream conditions.**
13) **Increase passage efficiency of in-stream obstructions including culverts, bridges, diversion structures, and unscreened diversions.**
14) **Maintain passage efficiency through ongoing O&M activities.**

Priority Geographic Area: GA15, West Birch Creek from Bear Creek to top of gorge.

Priority Fish Species and Life Stages: Steelhead

Limiting Factors: water temperature, sediment, habitat quantity, and obstructions.

Priority Ranking:

Species	Steelhead	Spring Chinook	Fall Chinook	Coho	Bull Trout
Protection Ranking	14	Not present	Not present	Not present	Not present
Restoration Ranking	5	Not present	Not present	Not present	Not present

(LP = low priority) (HP=high priority due to restoration ranking) (HP*=high priority as per QHA)

Quantitative Habitat Objectives: 25% restoration of water temperature, 25% restoration of fine sediment, 25% restoration of large wood, 50% restoration of pools, 100% resolution of obstructions.

Qualitative Artificial Production Objectives: NA

Working Hypothesis: The implementation of the quantitative habitat objectives and Phase III will result in increased productivity for:

Steelhead – no increase

And increased abundance for:

Steelhead – from 2,650 to 2,674

Management Strategies in Order of Priority (strategies in bold were chosen for this GA):

1) Maintenance of Phase I and II, and implementation of Phase III Umatilla Basin Projects.
2) Purchase water rights from willing sellers.
3) Increase water conservation and irrigation efficiency.
4) **Modify zoning and flood control planning**. *Regulatory actions*
5) **Place large woody debris and large boulders.**
6) **Fence and plant riparian zones**.
7) **Modify channel and flood-plain function**.
8) **Construct pool and riffle habitat using in-stream modifications**.
9) **Maintain, relocate, or eliminate forest, public and private roads in riparian and sensitive areas.**
10) **Increase protective status of priority habitats.**
11) **Modify detrimental land use activities.** *Volunteer through PR and education*
12) **Restore upstream or headwater attributes to improve downstream conditions.**
13) **Increase passage efficiency of in-stream obstructions including culverts, bridges, diversion structures, and unscreened diversions.**
14) **Maintain passage efficiency through ongoing O&M activities.**

Priority Geographic Area: GA13, West Birch Creek from mouth to Bear Creek.

Priority Fish Species and Life Stages: Steelhead

Limiting Factors: water temperature, sediment, habitat quantity, obstructions, flow and channel stability.

Priority Ranking:

Species	Steelhead	Spring Chinook	Fall Chinook	Coho	Bull Trout
Protection Ranking	HP	Not present	Not present	Not present	Not present
Restoration Ranking	6	Not present	Not present	Not present	Not present

(LP = low priority) (HP=high priority due to restoration ranking) (HP*=high priority as per QHA)

Quantitative Habitat Objectives: 25% restoration of water temperature, 25% restoration of fine sediment, 25% restoration of large wood, 50% restoration of pools, 100% resolution of obstructions, 25% restoration in flow, and 25% restoration in bed scour, 25% restoration in bankfull width, 25% restoration in channel confinement.

Qualitative Artificial Production Objectives: NA

Working Hypothesis: The implementation of the quantitative habitat objectives and Phase III will result in increased productivity for:

Steelhead – no increase

And increased abundance for:

Steelhead – from 2,650 to 2,720

Management Strategies in Order of Priority (strategies in bold were chosen for this GA):

1) Maintenance of Phase I and II, and implementation of Phase III Umatilla Basin Projects.
2) **Purchase water rights from willing sellers.**
3) **Increase water conservation and irrigation efficiency**.
4) **Modify zoning and flood control planning**. *Regulatory actions*
5) **Place large woody debris and large boulders.**
6) **Fence and plant riparian zones**.
7) **Modify channel and flood-plain function**.
8) **Construct pool and riffle habitat using in-stream modifications**.
9) **Maintain, relocate, or eliminate forest, public and private roads in riparian and sensitive areas.**
10) **Increase protective status of priority habitats.**
11) **Modify detrimental land use activities.** *Volunteer through PR and education*
12) **Restore upstream or headwater attributes to improve downstream conditions.**
13) **Increase passage efficiency of in-stream obstructions including culverts, bridges, diversion structures, and unscreened diversions.**
14) **Maintain passage efficiency through ongoing O&M activities.**

Priority Geographic Area: GA14, Bear Creek (tributary of West Birch Creek)

Priority Fish Species and Life Stages: Steelhead

Limiting Factors: water temperature, sediment, and habitat quantity.

Priority Ranking:

Species	Steelhead	Spring Chinook	Fall Chinook	Coho	Bull Trout
Protection Ranking	HP	Not present	Not present	Not present	Not present
Restoration Ranking	12	Not present	Not present	Not present	Not present

(LP = low priority) (HP=high priority due to restoration ranking) (HP*=high priority as per QHA)

Quantitative Habitat Objectives: 50% restoration of water temperature, 50% restoration of fine sediment, 50% restoration of large wood, and 50% restoration of pools.

Qualitative Artificial Production Objectives: NA

Working Hypothesis: The implementation of the quantitative habitat objectives and Phase III will result in increased productivity for:
Steelhead – no increase
And increased abundance for:
Steelhead – from 2,650 to 2,666

Management Strategies in Order of Priority (strategies in bold were chosen for this GA):

1) Maintenance of Phase I and II, and implementation of Phase III Umatilla Basin Projects.
2) Purchase water rights from willing sellers.
3) Increase water conservation and irrigation efficiency.
4) Modify zoning and flood control planning. *Regulatory actions*
5) **Place large woody debris and large boulders.**
6) **Fence and plant riparian zones**.
7) Modify channel and flood-plain function.
8) **Construct pool and riffle habitat using in-stream modifications**.
9) **Maintain, relocate, or eliminate forest, public and private roads in riparian and sensitive areas.**
10) **Increase protective status of priority habitats.**
11) **Modify detrimental land use activities.** *Volunteer through PR and education*
12) Restore upstream or headwater attributes to improve downstream conditions.

13) Increase passage efficiency of in-stream obstructions including culverts, bridges, diversion structures, and unscreened diversions.
14) Maintain passage efficiency through ongoing O&M activities.

Priority Geographic Area: GA19, East Birch Creek from Pearson Creek to headwaters including Pearson Creek.

Priority Fish Species and Life Stages: Steelhead

Limiting Factors: habitat quantity.

Priority Ranking:

Species	Steelhead	Spring Chinook	Fall Chinook	Coho	Bull Trout
Protection Ranking	HP	Not present	Not present	Not present	Not present
Restoration Ranking	9	Not present	Not present	Not present	Not present

(LP = low priority) (HP=high priority due to restoration ranking) (HP*=high priority as per QHA)

Quantitative Habitat Objectives: 50% restoration of large wood and 50% restoration of pools.

Qualitative Artificial Production Objectives: NA

Working Hypothesis: The implementation of the quantitative habitat objectives and Phase III will result in increased productivity for:

Steelhead – from 4.9 to 5.1

And increased abundance for:

Steelhead – 2,650 to 2,701

Management Strategies in Order of Priority (strategies in bold were chosen for this GA):

1) Maintenance of Phase I and II, and implementation of Phase III Umatilla Basin Projects.
2) Purchase water rights from willing sellers.
3) Increase water conservation and irrigation efficiency.
4) Modify zoning and flood control planning. *Regulatory actions*
5) **Place large woody debris and large boulders.**
6) **Fence and plant riparian zones**.
7) Modify channel and flood-plain function.
8) **Construct pool and riffle habitat using in-stream modifications**.

9) **Maintain, relocate, or eliminate forest, public and private roads in riparian and sensitive areas.**
10) **Increase protective status of priority habitats.**
11) **Modify detrimental land use activities.** *Volunteer through PR and education*
12) Restore upstream or headwater attributes to improve downstream conditions.
13) Increase passage efficiency of in-stream obstructions including culverts, bridges, diversion structures, and unscreened diversions.
14) Maintain passage efficiency through ongoing O&M activities.

Priority Geographic Area: GA18, East Birch Creek from California Gulch to Pearson Creek.

Priority Fish Species and Life Stages: Steelhead

Limiting Factors: sediment and habitat quantity.

Priority Ranking:

Species	Steelhead	Spring Chinook	Fall Chinook	Coho	Bull Trout
Protection Ranking	11	Not present	Not present	Not present	Not present
Restoration Ranking	11	Not present	Not present	Not present	Not present

(LP = low priority) (HP=high priority due to restoration ranking) (HP*=high priority as per QHA)

Quantitative Habitat Objectives: 50% restoration of fine sediment, 50% restoration of large wood, and 50% restoration of pools.

Qualitative Artificial Production Objectives: NA

Working Hypothesis: The implementation of the quantitative habitat objectives and Phase III will result in increased productivity for:

Steelhead – no increase

And increased abundance for:

Steelhead – from 2,650 to 2,665

Management Strategies in Order of Priority (strategies in bold were chosen for this GA):

1) Maintenance of Phase I and II, and implementation of Phase III Umatilla Basin Projects.
2) Purchase water rights from willing sellers.

3) Increase water conservation and irrigation efficiency.
4) **Modify zoning and flood control planning.** *Regulatory actions*
5) **Place large woody debris and large boulders.**
6) **Fence and plant riparian zones**.
7) **Modify channel and flood-plain function.**
8) **Construct pool and riffle habitat using in-stream modifications**.
9) **Maintain, relocate, or eliminate forest, public and private roads in riparian and sensitive areas.**
10) **Increase protective status of priority habitats.**
11) **Modify detrimental land use activities.** *Volunteer through PR and education*
12) **Restore upstream or headwater attributes to improve downstream conditions.**
13) Increase passage efficiency of in-stream obstructions including culverts, bridges, diversion structures, and unscreened diversions.
14) Maintain passage efficiency through ongoing O&M activities.

Priority Geographic Area: GA17, East Birch Creek from mouth to California Gulch.

Priority Fish Species and Life Stages: Steelhead

Limiting Factors: water temperature, sediment, and habitat quantity.

Priority Ranking:

Species	Steelhead	Spring Chinook	Fall Chinook	Coho	Bull Trout
Protection Ranking	HP	Not present	Not present	Not present	Not present
Restoration Ranking	10	Not present	Not present	Not present	Not present

(LP = low priority) (HP=high priority due to restoration ranking) (HP*=high priority as per QHA)

Quantitative Habitat Objectives: 25% restoration of temperature, 25% restoration of fine sediment, 25% restoration of large wood, and 25% restoration of pools.

Qualitative Artificial Production Objectives: NA

Working Hypothesis: The implementation of the quantitative habitat objectives and Phase III will result in increased productivity for:

Steelhead – no increase

And increased abundance for:

Steelhead – from 2,650 to 2,652

Management Strategies in Order of Priority (strategies in bold were chosen for this GA):

1) Maintenance of Phase I and II, and implementation of Phase III Umatilla Basin Projects.
2) **Purchase water rights from willing sellers.**
3) **Increase water conservation and irrigation efficiency.**
4) **Modify zoning and flood control planning.** *Regulatory actions*
5) **Place large woody debris and large boulders.**
6) **Fence and plant riparian zones**.
7) **Modify channel and flood-plain function.**
8) **Construct pool and riffle habitat using in-stream modifications**.
9) **Maintain, relocate, or eliminate forest, public and private roads in riparian and sensitive areas.**
10) **Increase protective status of priority habitats.**
11) **Modify detrimental land use activities.** *Volunteer through PR and education*
12) **Restore upstream or headwater attributes to improve downstream conditions.**
13) Increase passage efficiency of in-stream obstructions including culverts, bridges, diversion structures, and unscreened diversions.
14) Maintain passage efficiency through ongoing O&M activities.

Priority Geographic Area: GA26, Wildhorse Creek mouth to Athena.

Priority Fish Species and Life Stages: Coho

Limiting Factors: sediment.

Priority Ranking:

Species	Steelhead	Spring Chinook	Fall Chinook	Coho	Bull Trout
Protection Ranking	LP	Not present	Not present	HP	Not present
Restoration Ranking	LP	Not present	Not present	4	Not present

(LP = low priority) (HP=high priority due to restoration ranking) (HP*=high priority as per QHA)

Quantitative Habitat Objectives: 25% restoration of fine sediment.

Qualitative Artificial Production Objectives: Continue steelhead and coho hatchery programs to maintain and enhance production in the improved GA.

Working Hypothesis: The implementation of the quantitative habitat objectives and Phase III will result in increased productivity for:

Coho – no increase

And increased abundance for:

Coho – no increase

Management Strategies in Order of Priority (strategies in bold were chosen for this GA):

1) Maintenance of Phase I and II, and implementation of Phase III Umatilla Basin Projects.
2) Purchase water rights from willing sellers.
3) Increase water conservation and irrigation efficiency.
4) Modify zoning and flood control planning. *Regulatory actions*
5) Place large woody debris and large boulders.
6) **Fence and plant riparian zones**.
7) **Modify channel and flood-plain function.**
8) Construct pool and riffle habitat using in-stream modifications.
9) **Maintain, relocate, or eliminate forest, public and private roads in riparian and sensitive areas.**
10) **Increase protective status of priority habitats.**
11) **Modify detrimental land use activities.** *Volunteer through PR and education*
12) **Restore upstream or headwater attributes to improve downstream conditions.**
13) Increase passage efficiency of in-stream obstructions including culverts, bridges, diversion structures, and unscreened diversions.
14) Maintain passage efficiency through ongoing O&M activities.

Special Note on Bull Trout and DBTRP

The Draft Revised Bull Trout Recovery Plan (DRBTRP) provides a comprehensive discussion of what is known about bull trout status in the Umatilla Basin as well as discussion on what biologists believe are the primary factors that limit bull trout production in the basin. The DRBTRP lists operation and maintenance of dams and other diversion structures, forest management, livestock grazing, agriculture, agricultural diversions, urbanization, flood control management as land and water management activities that depress bull trout populations. Liberal harvest regulations and fish stocking programs are also implicated in the decline of bull trout. Existing land management facilities and activities that contribute to habitat problems are cited in the DRBTRP as riparian road and railroad construction and use and associated toxic spills, riparian grazing, riparian (and to a lesser extent, upland) timber harvest, recreational and municipal water developments and withdrawals, recreational use of riparian areas, livestock water developments, channel modification for flood control, agricultural development and competition with stocked hatchery rainbow trout. While the preceding limiting factors are listed in the DRBTRP there is no linkage made between biological limiting factors and proposed actions. The DRBTRP does list prioritized actions to address factors listed for bull trout. Part of our management plan objectives is to ensure that the objectives, strategies and priorities of the DRBTRP are coordinate with the objectives, strategies, and priorities outlined in this plan.

5.3.2.2 Willow Creek QHA Management Plan

As indicated in the assessment, redband trout are the only salmonid fish species that reside in Willow Creek. Anadromous fish are blocked from spawning and rearing areas by physical passage barriers and low instream flow. While the focus of habitat restoration and protection actions described below are for redband trout, work needs to be done to assess the feasibility of restoring steelhead to Willow Creek, as they were present historically. One of the weaknesses of the QHA done for Willow Creek is the lack on information on passage problems. Planners are aware of the location and description of a few of the barriers in the watershed, but many more exist and have not been inventoried for passage. To assess the feasibility of restoring steelhead in the watershed and to better understand the impacts of passage on redband trout, it is highly recommended that a comprehensive inventory of physical passage barriers and flow limitations be conducted. Free passage throughout the Willow Creek watershed would benefit redband trout and provide steelhead the opportunity to utilize the habitat in the basin, to the extent of the current productive capacity of the basin in terms of habitat. Therefore, passage issues, both removal and or modification of upstream barriers and diversion screening should be addressed wherever and whenever the opportunities arise. Inventory and prioritization of passage problems should be done before implementation of improvements to insure that the sites most advantageous to fish restoration are corrected first.

The major limiting factors recognized by QHA for redband trout in Willow Creek and its tributaries are:

- channel form – the condition of the channel in regard to bed scour and artificial confinement and the ability to form “normal” sequences of stream unit types (relates to habitat quantity and channel stability in table 4)
- riparian condition – condition of stream-side vegetation, land form, and subsurface water flow (relates to habitat diversity and water temperature in table 4)
- fine sediment – amount of fine sediment within the stream, especially in spawning riffles
- channel complexity – diversity/complexity of the cannel including amount of large woody debris and braided channels (relates to habitat diversity in table 4)
- pollution – introduction of toxic (acute and chronic) substances into the stream (not addressed in table 4, but addressed by strategies 1, 3, 6, 7, 8, and 9 shown below)
- obstructions – impediments to fish passage (this is addressed below under subheading *Passage Problems)*
- low flow – frequency and magnitude of low flow events

These limiting factors will be addressed with many of the same strategies used to address problems in the Umatilla subbasin geographic areas described above. Specifically the following strategies will be used to address the limiting factors in Willow Creek:

1) Modify zoning and flood control planning. *Regulatory actions*
2) Place large woody debris and large boulders.
3) Fence and plant riparian zones.
4) Modify channel and flood-plain function.
5) Construct pool and riffle habitat using in-stream modifications.
6) Maintain, relocate, or eliminate forest, public and private roads in riparian and sensitive areas.
7) Increase protective status of priority habitats.
8) Modify detrimental land use activities. *Volunteer through PR and education*
9) Restore upstream or headwater attributes to improve downstream conditions.
10) Increase passage efficiency of in-stream obstructions including culverts, bridges, diversion structures, and unscreened diversions.
11) Maintain passage efficiency through ongoing O&M activities.

Table 4. Management strategies (by number) and their general type and the limiting factors they address.

Limiting Factor ➔	**Habitat Quantity**	**Habitat Diversity**	**Channel Stability**	**Sediment**	**Low Flow**	**High Temper-ature**	**Passage**
Address Ongoing Causative Factors	1,3,7,8	1,3,6,7,8	1,3,6,7,8	1,3,6,7,8	1,7,8	1,7,8	10,11
Restore Natural Processes	1,3,4,6,7,8, 9,10	1,3,4,6,7,8, 9	1,4,6,7,8, 9	1,3,4,6,7, 8,9	1,3,4,7 ,8,9	1,3,4,7,8, 9	4,9,10, 11
Artificially Enhance Natural Processes	2,3,4,5	2,3,4,5	2,3,4,5	2,3,4,5	3,4	2,3,4,5	4,10,11

5.3.2.3 Areas for Protection

In addition to the restoration priority areas, priority geographic areas for protection were identified in the Assessment section of the subbasin plan. These are the areas that the EDT analysis suggests would have the most negative impacts on the focal species if they were allowed to degrade further. Within protection areas, actions appropriate to secure protection and/or avoid degradation include 1) conservation easements and other agreements that secure the protection of the stream and riparian zone for a significant period of time, 2) passive restoration actions, and 3) upland practices installed to prevent sediment transport the stream such as CRP, filter strips, sediment retention basins, terracing, etc. Passive restoration actions are defined as a change in land use that allows the stream and riparian zone to recover naturally from past impacts. Passive restoration includes the planting of native vegetation. These are actions that will protect the habitat on which the focal species depend on from degrading any further. In most cases, modest improvements in habitat attributes can be expected from these measures within the 10-15 year planning window. Protective actions are not limited to the priority protection areas, but may also be done in the priority restoration areas. It is the intention of the subbasin plan to limit these actions outside of the priority geographic areas. However, it is also understood and intended that factors limiting fish within a particular geographic area, such as sediment, must be addressed within the geographic area, but also upstream where significant sources exist.

5.3.2.4 Passage Problems

It was deemed necessary to include a special section on passage problems in the Umatilla/Willow subbasin because both EDT and QHA most likely have underestimated the impact of passage problems as a result of little work that has been conducted to determine the severity of known passage problems and to thoroughly survey the subbasin to identify all potential passage problems. Passage problems have been identified as: obstructions, unscreened diversions, and dry stream reaches. These prolems and the strategies to address them are outlined below.

Obstructions

Passage obstructions are considered a source of potential immediate mortality to fish. Delay in passage can expose fish to habitat conditions that could be adverse to survival without the opportunity to escape. Delay in passage can also affect the ability of salmonids to successfully spawn. Fish can also be physically injured by inadequate passage facilities increasing exposure to disease or possibly causing direct mortality from the injuries. In the Umatilla basin, 36 barriers are identified in the Assessment, Section 3.5.1.2. Not all of the barriers were included in the EDT analysis due to oversight. A complete inventory of passage obstructions has not been completed in non-anadromous waters of the Umatilla/Willow subbasin (McKay, Butter and Willow creeks) even though some barriers are listed in the table below. In general, the EDT analysis under estimates the impact passage obstructions due to lack of complete knowledge and by oversight when the EDT reaches were developed.

Because passage obstructions are likely to cause immediate mortality, they are considered imminent threats and should be addressed wherever they occur. The obstructions listed in Section 3.5.1.2 need to be addressed in order of priority, high, medium or low.

McKay, Butter and Willow creeks all historically supported summer steelhead, but steelhead are not currently present due to passage obstructions and low flow problems. McKay Dam, was constructed to store water for irrigation in the 1920's completely blocks upstream passage of fish at RM 6. Until recent years, McKay Creek downstream of McKay Dam was completely de-watered when the reservoir was being filled. Butter

Creek has a series of large diversion dams that block upstream passage throughout the basin. In addition, water withdrawal for irrigation is so severe that water flows out of the mouth for only a few days or weeks in any given year. Willow Creek Dam Was constructed in 1980 on Willow Creek just upstream of Heppner (RM 56) for flood control. Willow Creek Dam completely blocks upstream passage of fish. In addition, to Willow Creek Dam, numerous irrigation diversion dams exist throughout the Willow Creek watershed that block passage. The lowest barrier in Willow Creek that blocks anadromous passage exists at RM 11. Steelhead are occasionally seen holding downstream of this dam.

While the general condition of passage in these streams (McKay, Butter and Willow creeks) is understood, a thorough inventory and assessment is needed. This information can be used to pursue passage improvement for redband trout and to assess the feasibility of restoring passage for anadromous fish. While McKay and Butter creeks were included in the EDT analysis for steelhead to gain an understanding of historic contribution of these streams, there are no current plans to pursue anadromous fish restoration in these streams. Rather, the inventory/assessment of passage and screening should be completed so that future planning efforts can make informed decisions regarding the possibility of anadromous fish restoration. The same is true for Willow Creek.

<u>Water Diversions/Screens</u>
Water diversions that are not screened or are inadequately screened are a well documented source of mortality to salmonids, particularly juveniles. If fish screens do not have the correct flows across the screen or if mesh size is wrong, fish may be impinged on the surface. A water diversion, pump or gravity, that is not screened or has too large mesh may physically divert the fish out of the stream and into a waterway that is not suitable for survival. The installation of screens that meet current NOAA standards is considered a priority for the Umatilla/Willow Subbasin. In addition, projects that move diversions out of salmonid bearing waters do, in effect, remove a potential source of mortality and should also be considered a priority under this management strategy.

In the portion of the Umatilla Basin currently accessible to anadromous fish, there is only one recently identified gravity diversion that is not adequately screened within anadromous fish bearing waters. There has not been an inventory of pump type diversions and it is not known to what degree that pumps are screened. This is a significant data gap and is a high priority. Inventories of diversions have not been conducted in the McKay, Butter and Willow creek watersheds, which currently do not support anadromous fish. This is a significant data gap and should be considered a high priority for protection of resident trout.

<u>Dry Stream Reaches</u>
There are some stream reaches within the Umatilla/Willow subbasin that go dry on a seasonal basis. Some of these may be caused by the natural hydrological regime of the area; others may be anthropogenic in origin. Anthropogenic causes can be water diversions, vegetation removal, soil removal or compaction and alteration of stream/floodplain function , which reduces the infiltration of water in the watershed.

While this plan does not advocate the implementation of resources for introducing water to a section of the stream at a time of year when water historically was not present; every effort should be made to return water to areas that are de-watered due to causes mentioned above. Projects could include Phase 3 of the Umatilla Basin Water Exchange Project, water leases or purchases and water conservation. In addition, larger projects that restore the riparian areas or stream/floodplain function should be encouraged.

5.3.2.5 Artificial Production

Background: The Umatilla Basin represents one of several diverse management strategies that tribal and state fisheries managers are implementing in Northeast Oregon. The neighboring John Day Basin is managed for wild fish production only with no hatchery intervention for any species. The Grande Ronde Basin is implementing a spring chinook hatchery program that is based on genetic conservation of a listed species. In addition there is a segregated harvest mitigation hatchery program for summer steelhead. The Umatilla Basin utilizes a third strategy which uses an integrated hatchery intervention approach to restore or enhance natural production while simultaneously providing harvest opportunity. These integrated hatchery programs typically utilize tributary returns for broodstock which is the case in the Umatilla Subbasin with the exception of coho. The management strategy in the Umatilla provides for much more harvest opportunity than the strategies in neighboring basins.

Umatilla Hatchery, constructed and operated under the Fish and Wildlife Program, is the central production facility for the Umatilla Basin Fish Restoration Program. It is operated by ODFW and currently produces summer steelhead, spring chinook, and subyearling fall chinook salmon. A number of out of basin hatchery facilities also produce fish for the program. Bonneville Hatchery produces yearling fall chinook, Little White Salmon Hatchery produces spring chinook, and Cascade Hatchery and Lower Herman Creek Ponds produce coho salmon.

An integral part of the artificial production program in the basin includes juvenile acclimation and adult holding and spawning satellite facilities. These facilities are operated by CTUIR under the Umatilla Hatchery Satellite Facilities Operation and Maintenance project. There are five acclimation facilities; Bonifer Pond, Minthorn Springs, Imeques C-mem-ini-kem, Thornhollow, and Pendleton. The first acclimation facility (Bonifer) was constructed and began operations in 1983. With the completion of the Pendleton facility in 2000, all juvenile salmon and steelhead released into the basin can now be acclimated. There are also three adult facilities associated with the Fish Restoration Program. Holding and spawning of broodstock occurs at Minthorn for summer steelhead, at Three Mile Dam for fall chinook, and at South Fork Walla Walla for spring chinook. Broodstock are collected and transported from the Three Mile Dam Adult Trapping and Handling Complex by the Umatilla River Fish Passage Operations project.

Recommendations: The benefits of passive and active habitat restoration strategies presented in above show that natural production alone (restoration scenario 3) in the Umatilla Basin is not going to achieve the magnitude of total adult objectives listed in past plans. Hatchery intervention will be required in order to meet the return objectives stated in Table 2. Managers will need to continue to refine the EDT outputs to clarify the balance between natural production and artificial production that will meet subbasin adult return expectations and needs.

<u>Recommended Artificial Propagation Strategies and Actions for the Umatilla Program</u>
Strategy 1: Continue to supplement the recently reintroduced spring chinook population with a hatchery program utilizing Carson stock brood returning to the Umatilla River to provide for natural production and harvest.

> Action 1.1 Continue releasing 810,000 yearling spring chinook smolts from acclimation facilities into historic spring chinook habitat in the upper Umatilla River Subbasin.

Strategy 2: Continue to supplement the recently reintroduced fall chinook population with a hatchery program utilizing upriver bright stock brood returning to the Umatilla River and Priest Rapids Hatchery to provide for natural production and harvest.

> Action 2.1 Continue the John Day Mitigation program release of 480,000 yearling fall chinook smolts from acclimation facilities into historic fall chinook habitat in the mid Umatilla River Subbasin.

> Action 2.2 Continue the interim evaluation program release of 600,000 subyearling fall chinook smolts into historic fall chinook habitat in the mid and upper Umatilla River Subbasin. The evaluation program direct stream releases half the production into the mid Umatilla River Subbasin and half the production from acclimation facilities in the upper portion of the subbasin.

> Action 2.3 Continue the outplanting of up to 1,000 fall chinook adults from Priest Rapids and/or Ringold hatcheries into historic fall chinook habitat in the mid Umatilla River Subbasin to supplement natural spawning.

Strategy 3: Continue to supplement the recently reintroduced coho population with a hatchery program utilizing early run stock brood from Bonneville Hatchery to provide for natural production and harvest.

> Action 3.1 Continue the Mitchell Act program release of 1,500,000 yearling coho smolts from acclimation facilities into historic coho habitat in the mid-Umatilla River Subbasin.

Strategy 4: Continue to supplement the indigenous summer steelhead population with a hatchery program utilizing native stock brood returning to the Umatilla River to enhance natural production and provide harvest opportunity.

Action 4.1 Continue releasing of 150,000 yearling summer steelhead smolts from acclimation facilities into historic summer steelhead habitat in the mid-to-upper Umatilla River Subbasin.

5.3.2.6 Taxa of Interest

Pacific Lamprey

A Pacific lamprey restoration plan for the Umatilla Basin was developed by CTUIR in 1999. Since then, adult Pacific lamprey collected from the John Day River and the mainstem Columbia River been used to reestablish larval abundance in the Umatilla River by outplanting them in prime natural production locations close to spawning time. The goal is to outplant 500 adults annually into the Umatilla River to begin restoration efforts. Successful spawning and juvenile production is being documented by CTUIR. Continued evaluation of adult outplanting and habitat enhancement actions will be necessary to determine and ensure success of restoration efforts.

The numerous habitat enhancement actions ongoing and proposed for salmonids are expected to benefit Pacific lamprey. A serious habitat limitation still however exists in the lower Umatilla River below Threemile Dam. Current flow enhancement programs did not initially envision adult lamprey migration needs and flows in July and the first half of August are insufficient to provide for upstream migration of lamprey. This is a period when peak migration is occurring in the mainstem Columbia River and lamprey are likely now attempting to enter the Umatilla River.

Recommended Pacific lamprey strategies and actions for the Umatilla Program
Strategy 1: Implement the Pacific lamprey restoration plan for the Umatilla Basin.

Action 1.1 Continue outplanting of adults as detailed in the Umatilla River Basin Pacific Lamprey Restoration Plan (CTUIR 1999).

Action 1.2 Determine reproductive success of adult outplants.

Action 1.3 Monitor for increases in larval abundance, juvenile outmigration and adult returns.

Action 1.4 Operate Umatilla Basin Project phase I pumps to provide instream flows for adult lamprey migration in the Umatilla River below Threemile Dam throughout the summer.

Freshwater Mussels

The CTUIR initiated a freshwater mussel research and restoration project in the Umatilla Basin beginning in 2003.

Recommended freshwater shellfish strategies and actions for the Umatilla Program
Strategy 1: Conduct initial investigations and develop a restoration plan for freshwater shellfish in the Umatilla River Basin (CTUIR).

Action 1.1 Conduct qualitative and quantitative surveys to assess shellfish populations.

Action 1.2 Survey genetic variation within and among Umatilla and selected Columbia River subbasins.

Action 1.3 Determine macrohabitat and physiochemical factors controlling distribution and abundance of shellfish.

Action 1.4 Determine the role of fish communities controlling distribution and abundance of shellfish.

Action 1.5 Develop and implement recovery plan for shellfish in the Umatilla Basin.

5.4 Terrestrial Wildlife Biological Objectives and Strategies

5.4.1 Wildlife Approach and Methods

As described in Section 5.1, the development of objectives and strategies for the terrestrial wildlife management plan was driven by the vision for the subbasin (Section 5.1), the current biological and ecological conditions, and the economic and social realities described in the assessment (Section 3.0). The biological objectives for wildlife describe the physical and biological changes within the subbasin needed to achieve the vision. For wildlife, these objectives (and their associated strategies) are primarily described in terms of changes needed in focal habitats, rather than in population-related attributes of focal or obligate species. Focal species-centered objectives and strategies are not appropriate for wildlife because of the lack of adequate information available on focal species needed to form biological objectives. Instead, the wildlife plan is composed primarily of habitat-centered objectives and strategies that focus on the ecological function of the habitat (i.e., its ability to provide the key environmental correlates identified for the focal and other obligate species in Section 3.4.2). Thus, the primary role of focal species in forming the management plan is in the use of their needs to define functional habitat and, in some cases, in the research, monitoring, and evaluation component of this plan.

Wildlife objectives and strategies were developed by the Umatilla/Willow Subbasin Terrestrial Wildlife Workgroup. See Section 2.2 for a list of members of that team. An early draft set of objectives and strategies for three habitat types (ponderosa pine, shrub-steppe, and grasslands) was presented at a public meeting on May 6, 2004 and suggestions provided at that meeting were used to revise the objectives and strategies.

Objectives and associated strategies were developed for each habitat, with the exception of General Objective 1, which applies to all eight focal habitats. This objective, which is not strictly a biological objective, was developed in response to data gaps that became apparent when conducting the subbasin assessment. Addressing these data gaps was deemed to be a high priority because the lack of knowledge presented a substantial obstacle in developing firm quantitative biological objectives for many habitats. Thus, completing General Objective 1 will be instrumental in implementing effective adaptive management in the subbasin for terrestrial wildlife species.

Biological objectives for each focal habitat type generally fall into one of three categories: protection, enhancement, and conversion. Protection objectives relate to increasing the legal or administrative protection of the habitat. Protected status in this plan corresponds to the definitions used for gap analyses generated by IBIS. Those definitions (Table 5) are consistent with four categories described in the USGS Gap Analysis Program Handbook (personal communication: C. Langhoff, NWHI, April 2004). It is important to note that protection, as used in this plan, does not preclude active management. In fact, the higher the protection, the more likely it is that management would prohibit activities that degrade or destroy habitat and would encourage practices that would mimic natural disturbances. Thus, there may be some overlap between objectives related to protection and those that address enhancement. However, enhancement objectives focus exclusively on maintaining or increasing the ecological function of focal habitats, especially with respect to focal and other obligate species. Finally, objectives related to conversion or restoration seek to increase the amount of focal habitat in the subbasin by converting it or restoring it from some other habitat type.

Table 5. Definitions used for gap analyses generated by IBIS. Definitions are from the Gap Analysis Program Handbook (http://www.gap.uidaho.edu/handbook/Stewardship/) and are derived from Scott et al. 1993, Edwards et al. 1994, and Crist et al. 1996.

Protected Status	Definition
High	An area having permanent protection from conversion of natural land cover and a mandated management plan in operation to maintain a natural state within which disturbance events (of natural type, frequency, intensity, and legacy) are allowed to proceed without interference or are mimicked through management.
Medium	An area having permanent protection from conversion of natural land cover and a mandated management plan in operation to maintain a primarily natural state, but which may receive uses or management practices that degrade the quality of existing natural communities, including suppression of natural disturbance.
Low	An area having permanent protection from conversion of natural land cover for the majority of the area, but subject to extractive uses of either a broad, low-intensity type (e.g., logging) or localized intense type (e.g., mining). It also confers protection to federally listed endangered and threatened species throughout the area.
None	There are no known public or private institutional mandates or legally recognized easements or deed restrictions held by the managing entity to prevent conversion of natural habitat types to anthropogenic habitat types. The area generally allows conversion to unnatural land cover throughout.

Where possible, objectives within each habitat type are prioritized. A biological objective priority is listed under each objective, with “1” being the highest priority. When objectives are equally important or cannot be prioritized to a greater degree because of a lack of information, they receive the same priority ranking. In addition, each set of strategies associated with an objective is also prioritized to the extent possible, using the same notation described for objectives.

One of the primary considerations in ranking objectives and strategies is the Council’s directive to “build from strength” (i.e., efforts to improve wildlife habitat begins with protecting and supporting the most productive habitat first). As such, general prioritization rules used include:

1) Increase protection of highest quality land first (to some minimal protection status), then concentrate on lower quality land.
2) Strategies that provide long-term protection will be a higher priority than strategies that provide shorter-term protection, all other factors being equal.
3) Strategies that meet multiple objectives are higher priority than strategies that benefit a limited number of objectives.

4) Strategies that provide benefits for aquatic and terrestrial focal species will be higher priority than strategies that only benefit terrestrial wildlife.

Although multiple alternative strategies were considered for every objective, strategies rejected are not specifically listed under each objective because they generally fell into three categories: 1) strategies that were not consistent with the economic, political, or social realities of the subbasin (as outlined in Section 3.1), 2) strategies that were believed to have a low chance of success, and/or 3) strategies that were not as efficient at producing results as the strategies eventually selected. For example, for shrub-steppe and grassland habitats, strategies specifically target low-yielding agricultural land for conversion through enrollment in cooperative programs and other methods rather than targeting agricultural lands that may include high-yield, economically valuable croplands. Subbasin planners believe both strategies are essentially equally as effective, and by focusing on low-yielding agricultural lands, subbasin planners take into account the economic, social, and political realities of the subbasin, which makes the strategy more likely to be implemented.

As discussed above, adaptive management plays a central role in the Umatilla/Willow wildlife plan, and is, in fact, built into the objectives. The completion of General Objective 1 will provide important information that can be used to refine and modify the biological objectives and strategies for each focal habitat, as needed. Additional information gained though research, monitoring, and evaluation (Section 5.5) will also be used to continually update the plan throughout its life.

5.4.2 Wildlife Objectives and Strategies

This section presents the biological objectives and strategies for each habitat type, following a brief review of the limiting factors, key environmental correlates, and an overview of the objectives for each habitat type. A justification section is associated with each biological objective and explains why a particular target was chosen (or why it was impossible to generate a target) and provides a rationale for prioritization. In addition, the justification describes the information from the subbasin assessment that was used to support the objectives and strategies. It should be noted that while the appropriate section of the assessment is cited, literature citations that appear in the assessment are not repeated in the management plan for the sake of brevity. Table 6 provides an overview of General Objective 1 and Tables 7-14 summarize the biological objectives and strategies for each focal habitat.

Table 6. Summary of General Objective 1, which applies to all eight focal habitat types in the Umatilla/Willow subbasin. See text for more description and justification.

General Objective 1: Complete a comprehensive review by 2007 of focal habitat types and their focal and obligate species in the Umatilla/Willow subbasin that can be used to guide habitat protection, enhancement, and conversion/restoration activities.	**Objective Priority:** 1
Strategy 1: Refine and field-truth data on the location, size, and spatial distribution of each of the focal habitat types existing in the subbasin. ***Strategy Priority:*** 1 **Strategy 2:** For each focal habitat type, determine the quality of all existing habitat in the subbasin and its ecological function as related to the habitat needs of selected focal species and other obligate species. ***Strategy Priority:*** 1 **Strategy 3:** Refine and update currently available data on the protected status of each focal habitat. ***Strategy Priority:*** 1 **Strategy 4:** Increase knowledge about focal and obligate species distribution, status, habitat needs, limiting factors, and general ecology. ***Strategy Priority:*** 1 **Strategy 5:** Identify areas not currently supporting focal habitats that, if converted to the focal habitat, would enlarge remnant size or enhance connectivity between two or more extant remnants. ***Strategy Priority:*** 1 **Strategy 6:** Identify areas that are spatially isolated from extant remnants of focal habitat that could be rehabilitated to provide new reservoir habitats for selected focal species and other obligate species. ***Strategy Priority:*** 1 **Strategy 7:** Use data obtained by Strategies 1-6 to create GIS overlays with areas prioritized for protection, enhancement, or conversion/restoration for each focal habitat type. ***Strategy Priority:*** 2 **Strategy 8:** Use adaptive management to refine or modify protection, enhancement, and conversion objectives for focal habitat types based on information provided by the completion of Strategies 1-7 ***Strategy Priority:*** 2	

Table 7. Summary of focal species, limiting factors, and prioritized biological objectives and strategies for mixed conifer forest habitat in the Umatilla/Willow subbasin. See text for more description and for justification of prioritization and selected targets.

MIXED CONIFER	
Focal Species: Pileated Woodpecker	
Limiting Factors: harvest, altered fire regimes, ponderosa pine encroachment, development, insect outbreaks, exotic plant invasion	
Biological Objective 1: Protect, at a medium or high level, all mature mixed conifer forest stands in the subbasin by 2020.	**Objective Priority:** 1
Strategy 1: Work with tribal and public land managers to administratively or legislatively protect to the desired level all mature conifer forest under their jurisdiction. ***Strategy Priority:*** 1 **Strategy 2:** Protect mature conifer forest habitat on private lands to the desired level using cooperative agreements, conservation easements, and/or fee title acquisition, where appropriate. ***Strategy Priority:*** 2	
Biological Objective 2: Enhance 50% of the degraded mixed conifer habitat in the Umatilla/Willow subbasin by 2020.	**Objective Priority:** 2
Strategy 1: Use fire management tools and silvicultural practices that lead to functional habitat for the Pileated Woodpecker and other obligate species. ***Strategy Priority:*** 1 **Strategy 2:** Fund and coordinate weed control efforts on private and public land. ***Strategy Priority:*** 2 **Strategy 3:** Modify livestock grazing practices, as necessary, to reduce negative impacts on vegetation. ***Strategy Priority:*** 2 **Strategy 4:** Ensure that natural ecological processes necessary for functional habitat are allowed to proceed. ***Strategy Priority:*** 2 **Strategy 5:** In conjunction with Strategies 1-4, use cooperative habitat programs and public education to promote the enhancement and restoration of mixed conifer habitat. ***Strategy Priority:*** 1	

Table 8. Summary of focal species, limiting factors, and prioritized biological objectives and strategies for ponderosa pine habitat in the Umatilla/Willow subbasin. See text for more description and for justification of prioritization and selected targets.

PONDEROSA PINE	
Focal Species: White-headed Woodpecker	
Limiting Factors: fire suppression/fir invasion, stand-replacing fire, harvest, exotic weed invasion, livestock grazing	
Biological Objective 1: Protect, at a medium or high level, all old growth ponderosa pine in the subbasin by 2020.	**Objective Priority:** 1
Strategy 2: Protect old growth ponderosa pine habitat on private lands to the desired level using cooperative agreements, conservation easements, and/or fee title acquisition, where appropriate. ***Strategy Priority:*** 1 **Strategy 1:** Work with tribal and public land managers to administratively or legislatively protect to the desired level all old growth ponderosa pine forest under their jurisdiction. ***Strategy Priority:*** 2	
Biological Objective 2: Enhance 50% of the degraded or converted ponderosa pine habitat in the Umatilla/Willow subbasin by 2020.	**Objective Priority:** 2
Strategy 1: Use fire management tools and silvicultural practices that lead to functional habitat for the White-headed Woodpecker and other obligate species. ***Strategy Priority:*** 1 **Strategy 2:** Fund and coordinate weed control efforts on private and public land. ***Strategy Priority:*** 2 **Strategy 3:** Modify livestock grazing practices, as necessary, to reduce negative impact on vegetation. ***Strategy Priority:*** 2 **Strategy 4:** Ensure that natural ecological processes necessary for functional habitat are allowed to proceed. ***Strategy Priority:*** 2 **Strategy 5:** In conjunction with Strategies 1-4, use cooperative habitat programs and public education to promote the enhancement and restoration of ponderosa pine dominated habitat. ***Strategy Priority:*** 1	

Table 9. Summary of focal species, limiting factors, and prioritized biological objectives and strategies for quaking aspen forest in the Umatilla/Willow subbasin. See text for more description and for justification of prioritization and selected targets.

QUAKING ASPEN FOREST	
Focal Species: Red-naped Sapsucker	
Limiting Factors: Intensive grazing by livestock and native ungulates, fire suppression, invasion of coniferous species	
Biological Objective 1: Protect, at a medium or high level, all aspen habitat in the subbasin by 2010.	**Objective Priority:** 1
Strategy 1: Work with tribal and public land managers to administratively or legislatively protect to the desired level all quaking aspen forest under their jurisdiction. ***Strategy Priority:*** 1 **Strategy 2:** Protect quaking aspen forest on private lands to the desired level using cooperative agreements, conservation easements, and/or fee title acquisition, where appropriate. ***Strategy Priority:*** 2	
Biological Objective 2: Enhance all quaking aspen forest by 2015.	**Objective Priority:** 1
Strategy 1: Use fire management tools and silvicultural practices that lead to functional habitat for the Red-naped Sapsucker and other obligate species. ***Strategy Priority:*** 1 **Strategy 2:** Modify livestock grazing practices that prevent the recruitment of aspen. ***Strategy Priority:*** 1 **Strategy 3:** Ensure that natural ecological processes necessary for functional habitat are allowed to proceed. ***Strategy Priority:*** 1	
Biological Objective 3: Convert a minimum of 100 acres of former aspen forest habitat in the Umatilla/Willow subbasin back to aspen forest by 2020.	**Objective Priority:** 2
Strategy 1: Identify areas, that if converted back to aspen forest, would increase patch size and/or decrease the isolation of remnant patches of aspen forest. ***Strategy Priority:*** 1 **Strategy 2:** Use cooperative habitat programs, public education, and technical silvicultural support to convert these areas to aspen forest. ***Strategy Priority:*** 2	

Table 10. Summary of focal species, limiting factors, and prioritized biological objectives and strategies for western juniper woodlands. See text for more description and for justification of prioritization and selected targets.

WESTERN JUNIPER WOODLANDS	
Focal Species: Ferruginous Hawk	
Limiting Factors: agricultural conversion, altered fire regimes, overgrazing, exotic plant invasions	
Biological Objective 1: Protect, at a medium or high level, all mature juniper in the subbasin by 2020.	**Objective Priority:** 1
Strategy 1: Protect isolated mature juniper trees and stands on private lands in shrub-steppe and grassland habitats to the desired level using cooperative agreements, conservation easements, and/or fee title acquisition, where appropriate. ***Strategy Priority:*** 1 **Strategy 2:** Work with public land managers to administratively or legislatively protect to the desired level all isolated mature juniper trees and stands in shrub-steppe and grassland habitats. ***Strategy Priority:*** 2	
Biological Objective 2: Enhance 25% of degraded juniper habitat in the Umatilla/Willow subbasin by 2020.	**Objective Priority:** 2
Strategy 1: Use fire management tools and silvicultural practices that lead to functional habitat for the Ferruginous Hawk, their prey, and other obligate species. ***Strategy Priority:*** 1 **Strategy 2:** Fund and coordinate weed control efforts on private and public land. ***Strategy Priority:*** 1 **Strategy 3:** Modify livestock grazing practices, as necessary, to reduce the negative impact on mature juniper and to decrease the spread of exotic weeds. ***Strategy Priority:*** 1 **Strategy 4:** Ensure that natural ecological processes necessary for functional habitat are allowed to proceed. ***Strategy Priority:*** 1 **Strategy 5:** In conjunction with Strategies 1-4, educate the public about the ecological importance of mature juniper habitat to increase local support of enhancement projects. ***Strategy Priority:*** 1	

Table 11. Summary of focal species, limiting factors, and prioritized biological objectives and strategies for shrub-steppe habitat. See text for more description and for justification of prioritization and selected targets. The "five critical areas" are areas in the Umatilla/Willow subbasin (Horn Butte-Willow Creek, Boardman Bombing Range, Boeing Lease Lands, the Umatilla Army Depot, and Juniper Canyon) that contain not only most of the existing low-elevation shrub-steppe habitat in the subbasin, but also the largest and highest quality remnants of that habitat.

SHRUB-STEPPE HABITAT	
Focal Species: Sage Sparrow	
Limiting Factors: agricultural conversion, exotic plant invasion, alteration of fire regimes, purposeful seeding of non-native grasses, overgrazing by livestock	
Biological Objective 1: Protect, at a medium or high level, all shrub-steppe habitat in the five critical areas by 2010.	**Objective Priority:** 1
Strategy 1: Work with public land and TNC managers to administratively or legislatively protect all shrub-steppe in the five critical areas, as needed. ***Strategy Priority:*** 1 **Strategy 2:** Protect shrub-steppe habitat on private lands in the five critical areas to the desired level using cooperative agreements, conservation easements, and/or fee title acquisition, where appropriate. ***Strategy Priority:*** 2	
Biological Objective 2: Maintain and **enhance** all high-quality shrub-steppe habitat in the five critical areas by 2010.	**Objective Priority:** 1
Strategy 1: Reduce exotic understory plants. ***Strategy Priority:*** 1 **Strategy 2:** Modify livestock grazing practices, as necessary, to reduce the negative impact on shrub-steppe vegetation and to decrease the spread of exotic weeds. ***Strategy Priority:*** 1 **Strategy 3:** Where ecologically appropriate, seed shrub-steppe areas. ***Strategy Priority:*** 2 **Strategy 4:** Where ecologically appropriate, increase bare ground. ***Strategy Priority:*** 2	
Biological Objective 3: Enhance all degraded shrub-steppe habitat in the five critical areas by 2020.	**Objective Priority:** 2
Strategy 1: Reduce exotic understory plants. ***Strategy Priority:*** 1 **Strategy 2:** Modify livestock grazing practices, as necessary, to reduce the negative impact on shrub-steppe vegetation and to decrease the spread of exotic weeds. ***Strategy Priority:*** 1 **Strategy 3:** Identify the ecological potential of the site and employ practices to restore sites towards that potential. ***Strategy Priority:*** 2 **Strategy 4:** In conjunction with Strategies 1-3, provide aid to private landowners in enhancing degraded shrub-steppe with management, technical, and financial assistance. ***Strategy Priority:*** 1	

Table 11 (continued). Summary of focal species, limiting factors, and prioritized biological objectives and strategies for shrub-steppe habitat. The "five critical areas" are areas in the Umatilla/Willow subbasin (Horn Butte-Willow Creek, Boardman Bombing Range, Boeing Lease Lands, the Umatilla Army Depot, and Juniper Canyon) that contain not only most of the existing low-elevation shrub-steppe habitat in the subbasin, but also the largest and highest quality remnants of that habitat.

SHRUB-STEPPE HABITAT (CONTINUED)	
Biological Objective 4: Protect, at a medium or high level, up to 50,000 acres of shrub-steppe outside of the five critical areas by 2020.	**Objective Priority:** 3
Strategy 1: Protect habitat on private lands outside of the five critical areas to the desired level using cooperative agreements, conservation easements, and/or fee title acquisition, where appropriate. ***Strategy Priority:*** 1 **Strategy 2:** Work with public land managers to administratively or legislatively protect shrub-steppe habitat outside of the five critical areas, as needed. ***Strategy Priority:*** 2	
Biological Objective 5: Enhance 25,000 acres of degraded shrub-steppe habitat targeted for protection in Objective 4 by 2020.	**Objective Priority:** 3
Strategy 1: Reduce exotic understory plants. ***Strategy Priority:*** 1 **Strategy 2:** Modify livestock grazing practices, as necessary, to reduce the negative impact on shrub-steppe vegetation and to decrease the spread of exotic weeds. ***Strategy Priority:*** 1 **Strategy 3:** Identify the ecological potential of the site and employ practices to restore sites towards that potential. ***Strategy Priority:*** 2 **Strategy 4:** In conjunction with Strategies 1-3, aid private land owners in enhancing degraded shrub-steppe with management, technical, and financial assistance. ***Strategy Priority:*** 1	
Biological Objective 6: Convert 25,000 acres of low-yielding agricultural land or CRP lands into functional shrub-steppe habitat by 2020.	**Objective Priority:** 3
Strategy 1: Encourage the conversion of lands currently enrolled in CRP into shrub-steppe habitat by providing technical assistance and financial incentives, within the conditions allowed under CRP contracts. ***Strategy Priority:*** 1 **Strategy 2:** Identify and prioritize agricultural lands that could increase shrub-steppe remnant size or establish connectivity between remnants, and work to 1) enroll them in conservation programs (such as CRP), 2) develop cooperative agreements, 3) implement conservation easements, and/or 4) acquire, where appropriate. ***Strategy Priority:*** 1 **Strategy 3:** Identify the ecological potential of sites to be converted and conduct practices to restore sites towards that potential. ***Strategy Priority:*** 2 **Strategy 4:** Encourage Congress and NRCS to alter CRP requirements in ways that favor the conversion and maintenance of CRP lands into shrub-steppe habitats. ***Strategy Priority:*** 3	

Table 12. Summary of focal species, limiting factors, and prioritized biological objectives and strategies for grasslands in the Umatilla/Willow subbasin. See text for more description and for justification of prioritization and selected targets.

INTERIOR GRASSLANDS	
Focal Species: Grasshopper Sparrow	
Limiting Factors: agricultural conversion, exotic weed invasion, purposeful seeding of non-native grasses, overgrazing, altered fire regimes.	
Biological Objective 1: Protect, at a medium or high level, 20,000-40,000 acres of grassland habitat in the subbasin by 2010.	**Objective Priority:** 1
Strategy 1: Protect functional grasslands on private lands to the desired level using cooperative agreements, conservation easements, and/or fee title acquisition, where appropriate. ***Strategy Priority:*** 1 **Strategy 2:** Work with tribal and public land managers who have native or ecologically functional interior grasslands under their jurisdiction to administratively or legislatively increase protected status to the desired level. ***Strategy Priority:*** 2	
Biological Objective 2: Maintain and/or **enhance** the 20,000-40,000 acres of grassland habitat targeted for protection in Objective 1 by 2020.	**Objective Priority:** 1
Strategy 1: Support the full funding and implementation of integrated weed management plans in the subbasin. ***Strategy Priority:*** 1 **Strategy 2:** Modify livestock grazing practices, as necessary, to reduce negative impacts on grassland vegetation and to decrease the spread of exotic weeds. ***Strategy Priority:*** 1 **Strategy 3:** Reestablish native plant communities where practical and cost effective. ***Strategy Priority:*** 2 **Strategy 4:** In conjunction with strategies 1-3, aid private landowners in maintaining and enhancing grasslands with management, technical, and financial assistance. ***Strategy Priority:*** 1	
Biological Objective 3: Enhance the ecological function and duration of benefits of over 200,000 acres of grassland habitat currently enrolled in CRP, EQIP, and WHIP in the subbasin as well as lands that will be enrolled in the future.	**Objective Priority:** 2
Strategy 1: Provide additional technical assistance and financial incentives to actively manage grasslands enrolled in CRP, EQIP, or WHIP to meet goals beyond the basic requirements of those programs. ***Strategy Priority:*** 1 **Strategy 2:** Work with the NRCS to increase the minimum conservation practice requirements of CRP. ***Strategy Priority:* 2** **Strategy 3:** Work with the NRCS and other public policy makers to develop recommendations to the U.S. Congress that they modify the Farm Bill so that CRP contracts are extended from 10 to 20 years. ***Strategy Priority:*** 2	

Table 12 (continued). Summary of focal species, limiting factors, and prioritized biological objectives and strategies for grasslands in the Umatilla/Willow subbasin. See text for more description and for justification of prioritization and selected targets.

INTERIOR GRASSLANDS (CONTINUED)	
Biological Objective 4: Convert 15,000 acres of non-native annual grassland or low yielding dryland agricultural land not currently enrolled in conservation programs to native grasslands by 2020 and work to provide long-lasting protection to those converted grasslands.	**Objective Priority:** 3
Strategy 1: Identify and prioritize agricultural lands that could increase existing grassland remnants or establish connectivity between grassland remnants, and work to 1) enroll them in conservation programs, 2) develop cooperative agreements, 3) implement conservation easements, and/or 4) acquire, where appropriate. ***Strategy Priority:*** 1 **Strategy 2:** Work with the NRCS to alter the CRP bid point allocation to reflect ecological need as assessed in the habitat mapping conducted in General Objective 1. ***Strategy Priority:*** 2	

Table 13. Summary of focal species, limiting factors, and prioritized biological objectives and strategies for herbaceous wetlands in the Umatilla/Willow subbasin. See text for more description and for justification of prioritization and selected targets.

HERBACEOUS WETLANDS	
Focal Species: Columbia spotted frog	
Limiting Factors: habitat conversion, draining, lowering of ground water level, separation of floodplain from the stream channel due to dikes and levees, exotic plant invasions, livestock grazing, exotic amphibians (primarily the bullfrog)	
Biological Objective 1: Protect, at a medium or high level, all herbaceous wetlands in the subbasin by 2010.	**Objective Priority:** 1
Strategy 1: Protect herbaceous wetlands on private lands to the desired level using cooperative agreements, conservation easements, and/or fee title acquisition, where appropriate. In addition, promote the use of existing federal and state incentive programs (e.g., WRP) to protect herbaceous wetlands ***Strategy Priority:*** 1 **Strategy 2:** Work with tribal and public land managers to administratively or legislatively increase protected status of all herbaceous wetlands under their jurisdiction. ***Strategy Priority:*** 2 **Strategy 3:** In conjunction with Strategies 1 and 2, educate private landowners and the general public about the ecological importance of herbaceous wetlands and existing regulations that protect wetlands. ***Strategy Priority:*** 1	
Biological Objective 2: Enhance and/or **maintain** all existing herbaceous wetlands in the subbasin by 2015.	**Objective Priority:** 1
Strategy 1: Restore natural hydrologic function where it has been disturbed by agricultural or developmental activities. ***Strategy Priority:*** 1 **Strategy 2:** Develop and implement techniques to reduce or eliminate bullfrogs. ***Strategy Priority:*** 1 **Strategy 3:** Reduce exotic plant species encroachment into remaining wetlands. ***Strategy Priority:*** 1 **Strategy 4:** Apply techniques to mimic natural disturbance regimes necessary to maintain native wetland vegetation and function. ***Strategy Priority:*** 1 **Strategy 5:** Enhance degraded, naturally-occurring wetland habitat on public or private land using moist soil techniques to establish permanent open-water refuge with a minimum water level as habitat for Columbia spotted frogs. ***Strategy Priority:*** 1	

Table 13 (continued). Summary of focal species, limiting factors, and prioritized biological objectives and strategies for herbaceous wetlands in the Umatilla/Willow subbasin. See text for more description and for justification of prioritization and selected targets.

HERBACEOUS WETLANDS (CONTINUED)	
Biological Objective 3: Convert or create 1,000 acres of additional herbaceous wetland habitat in the subbasin by 2020.	**Objective Priority:** 2
Strategy 1: Restore wetland habitat in areas identified as formerly having naturally-occurring wetland habitat. ***Strategy Priority:*** 1 **Strategy 2:** Create new wetland habitat in association with or connected to extant naturally-occurring wetlands in the subbasin. ***Strategy Priority:*** 2 **Strategy 3:** In conjunction with Strategies 1 and 2, work with federal agencies to implement wetland conservation and development programs such as the USDA's "Wetland Reserve Program" or USFWS's "Partners for Wildlife Program" in areas prioritized for restoration in the subbasin. ***Strategy Priority:*** 1	

Table 14. Summary of focal species, limiting factors, and prioritized biological objectives and strategies for riparian wetlands in the Umatilla/Willow subbasin. See text for more description and for justification of prioritization and selected targets.

RIPARIAN WETLANDS	
Focal Species: Great Blue Heron, Yellow Warbler, and the American beaver	
Limiting Factors: agricultural and urban development, exotic weed invasion, timber harvest, livestock grazing, hydropower, transportation corridors, recreational activities	
Biological Objective 1: Protect, at a medium or high level, all remaining riparian wetlands in the subbasin by 2010.	**Objective Priority:** 1
Strategy 1: Protect riparian wetlands on private lands to the desired level with cooperative agreements, conservation easements, and/or fee title acquisition. In addition, promote the use of existing federal and state incentive programs (e.g., CREP, EQIP, WRP, WHIP) to protect riparian areas. ***Strategy Priority:*** 1 **Strategy 2:** Work with public land managers who have riparian wetlands under their jurisdiction to ensure that those lands are administratively or legally protected to the desired level. ***Strategy Priority:*** 2	
Biological Objective 2: Enhance and maintain all existing riparian wetlands in the subbasin by 2015.	**Objective Priority:** 1
Strategy 1: Where necessary, re-establish natural riverine dynamics and floodplain/riverine interactions necessary for the establishment and maintenance of naturally-regenerating and functioning cottonwood galleries and other riparian vegetation. ***Strategy Priority:*** 1 **Strategy 2:** Where necessary, reduce exotic plant cover. ***Strategy Priority:*** 1 **Strategy 3:** Where necessary, modify livestock grazing practices that negatively impact riparian wetlands. ***Strategy Priority:*** 1 **Strategy 4:** Where necessary, plant native vegetation in areas where progress towards Strategies 1 and 2 is sufficient to allow native plants to survive. ***Strategy Priority:*** 2 **Strategy 5:** In conjunction with Strategies 1-4, work with federal agencies to implement wetland conservation and development programs such as the USDA's "Wetland Reserve Program" or USFWS's "Partners for Wildlife Program" in areas prioritized for restoration in the subbasin. ***Strategy Priority:*** 1	

Table 14 (continued). Summary of focal species, limiting factors, and prioritized biological objectives and strategies for riparian wetlands in the Umatilla/Willow subbasin. See text for more description and for justification of prioritization and selected targets.

RIPARIAN WETLANDS (CONTINUED)	
Biological Objective 3: Convert or restore 2,000 acres of non-functioning riparian area into ecologically functional riparian habitat by 2020.	**Objective Priority:** 2
Strategy 1: Where necessary, re-establish natural riverine dynamics and floodplain/riverine interactions necessary for the establishment and maintenance of naturally-regenerating and functioning cottonwood galleries and/or other riparian vegetation. ***Strategy Priority:*** 1 **Strategy 2:** Where necessary, reduce exotic plant cover. ***Strategy Priority:*** 1 **Strategy 3:** Where necessary, plant native hydrophilic vegetation in areas where progress towards Strategies 1 and 2 is sufficient to allow native plants to survive. ***Strategy Priority:*** 2 **Strategy 4:** Where necessary, modify livestock grazing practices that negatively impact riparian wetlands. ***Strategy Priority:*** 2 **Strategy 5:** In conjunction with Strategies 1-4, work with federal agencies to implement wetland conservation and development programs such as the USDA's "Wetland Reserve Program" or USFWS's "Partners for Wildlife Program" in areas prioritized for restoration in the subbasin. ***Strategy Priority:*** 1	

GENERAL OBJECTIVE 1

The first objective (General Objective 1) in the terrestrial wildlife portion of the plan is a general objective that encompasses all eight focal habitat types in the Umatilla/Willow subbasin. Although not a biological objective in the sense of providing a quantitative expression of biological and physical changes needed to address limiting factors, General Objective 1 is included in the terrestrial wildlife management plan because it forms the most necessary and integral step towards achieving the remaining objectives for each focal habitat type.

General Objective 1: Complete a comprehensive review by 2007 of each of the eight focal habitat types in the Umatilla/Willow subbasin that can be used to guide habitat protection, enhancement, and restoration/conversion activities. Knowledge generated can be used to refine objectives, strategies, and prioritizations via adaptive management.

Strategy 1: Refine and field-truth data on the location, size, and spatial distribution of each of the focal habitat types existing in the subbasin. ***Strategy Priority:*** 1

Strategy 2: For each focal habitat type, determine the quality of all existing habitat in the subbasin and its ecological function as related to the habitat needs of selected focal species and other obligate species (see Table 6). ***Strategy Priority:*** 1

Strategy 3: Refine and update currently available data (such as that provided by IBIS) on the protected status of each focal habitat. ***Strategy Priority:*** 1

Strategy 4: Increase knowledge about focal and obligate species distribution, status, habitat needs, limiting factors, and general ecology. ***Strategy Priority:*** 1

Strategy 5: Identify areas not currently supporting focal habitats that, if converted to the focal habitat, would enlarge remnant size or enhance connectivity between two or more extant remnants. ***Strategy Priority:*** 1

Strategy 6: Identify areas that are spatially isolated from extant remnants of focal habitat that could be rehabilitated to provide new reservoir habitats for selected focal species and other obligate species. ***Strategy Priority:*** 1

Strategy 7: Use data obtained by Strategies 1-6 to create GIS overlays with areas prioritized for protection, enhancement, or restoration for each focal habitat type. ***Strategy Priority:*** 2

Strategy 8: Use adaptive management to refine or modify protection, enhancement, and conversion objectives for focal habitat types based on information generated from the completion of Strategies 1-7. ***Strategy Priority:*** 2

Justification: Section 3.2.4.2 in the assessment describes the limitations of data concerning focal habitats in the subbasin. The most obvious of these limitations is the lack of information on the quality of most focal habitat and its ecological function with regard to the selected focal species and other obligate species. The limitations of current data on protected status of each habitat type are also discussed in Section 3.2.4.2. Because of its importance in guiding the biological objectives for each focal habitat type, General Objective 1 is a short-term objective with an anticipated date of completion of 2007. However, it should be noted that taking action on strategies associated with other objectives should not wait until the completion of General Objective 1 because much can be done with the current state of knowledge. Completing General Objective 1 will enhance existing efforts by providing the necessary information to form an integrated plan for each wildlife habitat that will be guided not only by opportunities that present themselves but also by a more holistic understanding of the protected status and condition of each habitat in the subbasin. Strategies 1-6 are of the highest priority because Strategies 7 and 8 are dependent upon their completion.

MIXED CONIFER FOREST

Limiting Factors: Although the area of mixed conifer forest in the Umatilla/Willow subbasin appears to have doubled since c. 1850, the quality of this habitat is believed to have declined due to timber harvest, altered fire regimes, ponderosa pine encroachment, development, outbreaks of western spruce budworm and Douglas-fir tussock moth, and exotic plant invasion (see Section 3.5.2). These factors have resulted in direct loss of old growth habitat and fragmentation and degradation of remaining mixed conifer forest. Loss of old growth habitat has occurred primarily because of timber harvesting, while habitat degradation is primarily associated with altered fire regimes. Fire suppression has promoted less fire-resistant, shade-tolerant trees, and led to mixed conifer forests with low snag density, high tree density, and stands dominated by smaller and more shade-tolerant trees. All of these factors are believed to be responsible for significant reductions in the Pileated Woodpecker and other mixed conifer obligate species.

Desired Functional Conditions/Key Environmental Correlates: As described in Section 3.4.2, the desired functional conditions or key environmental correlates for the Pileated Woodpecker and other mixed conifer obligates are:

- complex multi-layered closed canopies with a major component of large trees (>90 feet in height) and a high basal area
- mature seed producing trees
- numerous uneven-aged individual trees and an understory of smaller woody plants with emphasis on multi-conifer species composition including lodgepole pine, Douglas fir, Western larch, Engelmann spruce, subalpine fir, and white pine
- dead and dying trees 39 – 69 feet tall, 100-300 years old, and > 20 inches dbh
- dead and decaying wood, with an abundance of insects
- a minimum forest parcel size of 2,000 acres

Overview of Objectives: The objectives for mixed conifer habitat are prioritized in a way that is consistent with the Council's Fish and Wildlife Program strategy of "Build from Strength". Specifically, Biological Objective 1 aims to protect the most ecologically significant habitat first – mature mixed conifer stands. Although the amount of mature forest that needs increased protection is not currently known, it is suspected to be small. Biological Objective 2 seeks to expand management efforts to enhance up to 50% of degraded mixed conifer habitat in the subbasin in ways that increase the likelihood of sustaining healthy populations of the Pileated Woodpecker and other obligate species.

Biological Objective 1: Increase the protected status of all mature (i.e., dominant trees from 100-300 years old) mixed conifer forest stands in the subbasin with no or low level protection to medium or high level protection by 2020. Protection, guided by the completion of General Objective 1, will be prioritized based on the current or potential ecological function of the habitat with regard to focal and other obligate species and will target tracts that 1) are large and contiguous, 2) have the potential to restore connectivity, and/or 3) add to existing protected areas.
Objective Priority: 1

> **Strategy 1:** Work with tribal and public land managers who have mature mixed conifer forest under their jurisdiction to ensure that all of it is administratively or legislatively protected to the desired level. ***Strategy Priority:*** 1
>
> **Strategy 2:** Protect existing mature mixed conifer forest on private land to the desired level with cooperative agreements, conservation easements, and/or fee title acquisition. ***Strategy Priority:*** 2
>
> **Justification:** This objective cannot be quantified until the completion of General Objective 1 because it is not known how much mature mixed conifer forest exists in the subbasin, and how much of it is currently protected. As discussed in Section 3.2.4.2, less than 10% (<14,000 acres) of all mixed conifer forest in the subbasin is under medium or high level protection. All mature mixed conifer forest is targeted because 1) most (> 70%) mixed conifer is publicly owned, and therefore may be relatively easy to protect, 2) managers suspect that the amount of mature mixed conifer in the subbasin is small, 3) mature mixed conifer provides the habitat characteristics needed by the Pileated Woodpecker and other obligate mixed conifer forest species, and 4) mature forest dominated by trees at least 100 years old cannot be quickly replaced once destroyed. If information provided by further study, including the completion of General Objective 1, shows that this target is unrealistically high, then it will be decreased as necessary. This biological objective is the highest priority for mixed conifer habitat because it "builds from strength" in the sense of protecting the most productive habitat first. Within this objective, Strategy 1 is a higher priority than

Strategy 2 because most mixed conifer is under the control of government agencies (see Section 3.2.4.2).

Biological Objective 2: Enhance up to 50% of degraded mixed conifer habitat in the Umatilla/Willow subbasin by 2020. Enhancement, guided by the completion of General Objective 1, will target tracts that 1) are currently at high or medium level protection, 2) are large (>2,000 acres, if possible) and contiguous, 3) have the potential to restore connectivity, 4) add to existing protected areas, and/or 5) allow for the introduction of fire management strategies.
Objective Priority: 2

Strategy 1: Use fire management tools (e.g., prescribed burns) and silvicultural practices (e.g., selective harvesting) that lead to functional habitat for the Pileated Woodpecker and other obligate species. ***Strategy Priority:*** 1

Strategy 2: Fund and coordinate weed control efforts on private and public lands. ***Strategy Priority:*** 2

Strategy 3: Modify livestock grazing practices, as necessary, to protect the recruitment of shrubs, saplings, and understory vegetation**.** ***Strategy Priority:*** 2

Strategy 4: Ensure that natural ecological processes that are necessary for a functional habitat for focal and obligate species, such as fire and the retention of prone woody material, are allowed to proceed. ***Strategy Priority:*** 2

Strategy 5: In conjunction with Strategies 1-4, use cooperative habitat programs and public education to promote the enhancement and restoration of mixed conifer habitat. ***Strategy Priority:*** 1

Justification: A target of up to 50% was selected because managers assume that most of the more than 160,000 acres of mixed conifer in the subbasin is degraded at some level, and improving habitat on 80,000 acres by 2020 seems to be within the realm of possibility, if adequate funding is provided. Targeting tracts greater than 2,000 acres was selected to maximize the likelihood of meeting the requirements of Pileated Woodpeckers (see Section 3.2.4.2). This objective is ranked second to Objective 1 because it builds outward from old growth areas protected through Objective 1 to enhance, restore and build connectivity in remaining mixed conifer habitat. Strategy 1 is one of the highest priorities for this objective because it is believed to be an efficient way to address one of the most limiting factors in this habitat type -- altered fire regimes. Strategy 4 also addresses this limiting factor, but may be more difficult to implement with regard to fire. Strategy 5 is also of high priority because cooperative programs and public education are likely to make Strategies 1-4 more successful.

PONDEROSA PINE FOREST

Limiting Factors: Although the area of ponderosa pine forest in the Umatilla/Willow subbasin appears to have increased by over 10% since c. 1850, the quality of this habitat is believed to have declined due to mixed forest encroachment, altered fire regimes and stand-replacing fires, timber harvest, exotic plant invasion, outbreaks of western spruce budworm and Douglas-fir tussock moth, livestock grazing, development, and recreational activities (see Section 3.5.2). Two of the major factors responsible for habitat loss and degradation of functional ponderosa pine forest are harvest of late and old structure pine and the encroachment of Douglas-fir and grand fir into ponderosa pine dominated habitats. The encroachment is due primarily to fire suppression and intense, stand-replacing wildfires; the latter results from high fuel loads associated with increases in brushy species and the establishment of ladder fuels from encroaching shade tolerant understory trees. All of these factors are believed to have contributed to significant declines in the White-headed Woodpecker and other ponderosa pine obligate species.

Desired Functional Conditions/Key Environmental Correlates: As described in Section 3.4.2, the desired functional conditions or key environmental correlates for functional ponderosa pine habitat are:

- large patches (> 800 acres) of open mature/old growth-dominated ponderosa pine
- canopy closures between 30-50%
- 2.5 snags per acre, with each snag > 24 inches dbh
- sparse understory vegetation

Overview of Objectives: The objectives for ponderosa pine habitat are prioritized in a way that is consistent with the Council's Fish and Wildlife Program strategy of "Build from Strength". Specifically, Biological Objective 1 aims to protect the most ecologically significant habitat first – old growth ponderosa pine. Although the amount of old growth forest that needs increased protection is not currently known, it is suspected to be small. Biological Objective 2 seeks to expand management efforts to enhance up to 50% of degraded ponderosa pine habitat in the subbasin in ways that increase the likelihood of sustaining healthy populations of the White-headed Woodpecker and other obligate species.

Biological Objective 1: Increase the protective status of all old growth ponderosa pine habitat with mature, seed-producing trees in the subbasin with no or low level protection to medium or high level protection by 2020. Protection, guided by the completion of General Objective 1, will be prioritized based on the current or potential ecological function of the habitat with regard to the White-headed Woodpecker and other obligate species and will target tracts that 1) are large and contiguous, 2) have the potential to restore connectivity, and/or 3) add to existing protected areas.
Objective Priority: 1

Strategy 1: Protect existing old growth ponderosa pine on private land to the desired level with cooperative agreements, conservation easements, and/or fee title acquisition. ***Strategy Priority:*** 1

Strategy 2: Work with tribal and public land managers who have old growth ponderosa pine habitat under their jurisdiction to ensure that all of it is administratively or legislatively protected to the desired level. ***Strategy Priority:*** 2

Justification: This objective cannot be quantified until the completion of General Objective 1 because it is not known how much old growth ponderosa pine currently exists in the subbasin, and how much of it is currently protected. As discussed in Section 3.2.4.2, only 2% of all ponderosa pine in the subbasin is believed to be under high or medium level protection. All old growth is targeted for protection because 1) managers suspect that the amount of old growth remaining in the subbasin is small, 2) old growth ponderosa pine is the only stage that provides the habitat characteristics needed by the White-headed Woodpecker and other obligate ponderosa-pine species, and 3) old growth forest cannot be quickly replaced once destroyed. This biological objective is the highest priority for ponderosa pine habitat because it "builds from strength" in the sense of protecting the most productive habitat first. Within this objective, Strategy 1 is a higher priority than Strategy 2 because most ponderosa pine is privately owned (see Section 3.2.4.2).

Biological Objective 2: Enhance up to 50% of degraded or converted ponderosa pine habitat in the Umatilla/Willow subbasin by 2020. Enhancement, guided by the completion of General Objective 1, will target tracts that are 1) currently at high or medium level protection, 2) large (> 800 acres, if possible) and contiguous, 3) have the potential to restore connectivity, 4) add to existing protected areas, and/or 5) allow for the introduction of fire management strategies.
Objective Priority: 2

Strategy 1: Use fire management tools (e.g., prescribed burns) and silvicultural practices (e.g., selective harvesting) that lead to and maintain functional habitat for the White-headed Woodpecker and other obligate species. ***Strategy Priority:*** 1

Strategy 2: Fund and coordinate weed control efforts on private and public lands. ***Strategy Priority:*** 2

Strategy 3: Modify livestock grazing practices, as necessary, to protect the recruitment of shrubs, saplings, and understory vegetation**.** ***Strategy Priority:*** 2

Strategy 4: Ensure that natural ecological processes that are necessary for a functional habitat for focal and obligate species, such as fire and the retention of prone woody material, are allowed to proceed. ***Strategy Priority:*** 2

Strategy 5: In conjunction with Strategies 1-4, use cooperative habitat programs and public education to promote the enhancement and restoration of ponderosa pine dominated habitat. ***Strategy Priority:*** 1

Justification: A target of up to 50% was selected because managers assume that most of the more than 160,000 acres of ponderosa pine in the subbasin is degraded at some level, and improving habitat on 80,000 acres by 2020 seems within the realm of possibility, if adequate funding is provided. Targeting tracts greater than 800 acres was selected to maximize the likelihood of meeting the requirements of the White-headed Woodpecker (see Section 3.2.4.2). This objective is ranked second to Objective 1 because it builds outward from old growth areas protected through Objective 1 to enhance, restore and build connectivity in remaining ponderosa pine habitat. Strategy 1 is one of the highest priorities for this objective because it is believed to be an efficient way to address one of the most limiting factors in this habitat type -- altered fire regimes and the invasion of mixed conifer. Strategy 4 also addresses this limiting factor, but may be more difficult to implement with regard to fire. Strategy 5 is also of high priority because cooperative programs and public education are likely to make Strategies 1-4 more successful.

QUAKING ASPEN FOREST

Limiting Factors: Quaking aspen habitat is extremely limited in the Umatilla/Willow subbasin and is believed to be greatly reduced from historical conditions (see Section 3.2.4). As indicated in the assessment (see Section 3.5.2), the major factors affecting aspen habitat in the Umatilla/Willow subbasin are intensive grazing by livestock and native ungulates, fire suppression, and the invasion of coniferous species. These factors are believed to be responsible for significant reductions in Red-naped Sapsucker and other species highly dependent on quaking aspen forest.

Desired Functional Conditions/Key Environmental Correlates: As described in Section 3.4.2, the desired functional conditions or key environmental correlates for functional aspen habitat are:

- > 1.5 snags per acre
- trees > 39 feet in height and > 10 inch dbh
- patch size > 10 acres
- an abundance of trees with shelf fungus

Overview of Objectives: The objectives for quaking aspen forest habitat are prioritized in a way that is consistent with the Council's Fish and Wildlife Program strategy of "Build from Strength". Specifically, Biological Objectives 1 and 2 aim to protect and enhance all of the very limited amount of this habitat in the subbasin. Objective 3 seeks to roughly double the total amount of quaking aspen forest in the subbasin by 2020 to increase the likelihood of sustaining healthy populations of the Red-naped Sapsucker and other obligate wildlife species.

Biological Objective 1: Increase the protected status of all aspen habitat in the subbasin with no or low level protection to medium or high level protection by 2010.
Objective Priority: 1

> **Strategy 1:** Work with tribal and public land managers who have quaking aspen habitat under their jurisdiction to ensure that all of it is administratively or legislatively protected to the desired level. ***Strategy Priority:*** 1
>
> **Strategy 2:** Protect existing quaking aspen habitat on private land to the desired level with cooperative agreements, conservation easements, and/or fee title acquisition. ***Strategy Priority:*** 2
>
> **Justification:** This relatively short-term objective cannot be quantified until the completion of General Objective 1 because it is not known how much quaking aspen habitat exists in the subbasin and how much of it is currently protected. As discussed in Section 3.2.4.2, the habitat is believed to be extremely rare in the subbasin; IBIS reports only 46 acres for the Umatilla/Willow subbasin and data generated by CTUIR scientists suggest that an additional 32 acres exists on CTUIR land. Thus, all quaking aspen is targeted for protection by 2010 because 1) it is very rare, 2) this forest type has experienced a significant reduction across the western United States thereby making each aspen stand important to maintaining the genetic integrity of the species, and 3) it provides habitat characteristics preferred by the Red-naped Sapsucker and other obligate aspen forest species. Objectives 1 and 2 are of equally high priority because together they protect and enhance all remaining aspen habitat in the subbasin. Within Objective 1, Strategy 1 is of higher priority than Strategy 2 because most existing aspen is believed to occur on tribal or government controlled land.

Biological Objective 2: Enhance all aspen forest in the Umatilla/Willow subbasin by 2015.
Objective Priority: 1

> **Strategy 1:** Use fire management tools (e.g., prescribed burns) and silvicultural practices (e.g., selective harvesting) that lead to functional habitat for the Red-naped Sapsucker and other obligate species. ***Strategy Priority:*** 1
>
> **Strategy 2:** Modify livestock grazing practices that prevent the recruitment of aspen. ***Strategy Priority:*** 1

Strategy 3: Ensure that natural ecological processes, such as fire and the retention of decaying woody material, that are necessary for a functional habitat for the Red-naped Sapsucker and other aspen obligate species are allowed to proceed. ***Strategy Priority:*** 1

Justification: Because of the rarity and importance of aspen habitat in the subbasin, all aspen forest is targeted for enhancement by 2015 with the assumption that all of the habitat is degraded at some level. All strategies are of equal priority because all are considered to be necessary in addressing limiting factors for aspen habitat and individual aspen stands may vary with regard to which limiting factor is most problematic.

Biological Objective 3: Convert a minimum of 100 acres of former aspen forest in the Umatilla/Willow subbasin back into aspen forest habitat by 2020. Conversion of tracts that 1) are large and contiguous, 2) have the potential to restore connectivity, and/or 3) add to existing protected areas will be the highest priority.
Objective Priority: 2

Strategy 1: Use existing data on potential aspen sites and new data generated from the completion of General Objective 1 to identify areas that, if converted back to aspen forest, would increase patch size and/or decrease the isolation of remnant patches of aspen forest.

Strategy 2: Use cooperative habitat programs, public education and technical silvicultural support to convert these areas to aspen forest.

Justification: A target of 100 acres is selected because a preliminary study on CTUIR land alone has identified approximately 60 acres of habitat that appears to be suitable as aspen forest habitat (and, in fact, probably supported aspen forest in the past; see Section 3.2.4). As more data are generated from the completion of General Objective 1, this target may increase. This objective is of a lower priority than Objectives 1 and 2 because it does not protect or enhance existing aspen stands, but seeks to add new habitat to existing aspen forest in ways that should maximize size and connectivity.

WESTERN JUNIPER WOODLAND

Limiting Factors: Juniper woodlands are found in two general areas of the subbasin: 1) on the foothills of the Blue Mountains in a mid-elevation transitional zone between ponderosa pine and grasslands/shrub-steppe habitats (see Figure x), and 2) as isolated trees or patches at lower elevations in shrub-steppe habitat. Unlike neighboring subbasins, such as the John Day subbasin, the invasion of juniper found in transitional zones into grasslands of the Umatilla/Willow subbasin is not a serious problem. Although the current distribution of mid-elevation transitional zone juniper woodland in the Umatilla/Willow subbasin compared to historical conditions is unclear (see Section

3.2.4.2), it has probably increased slightly or remained relatively constant. In contrast, juniper habitat associated with grassland and shrub-steppe are believed to be decreasing markedly (see Section 3.2.4.2), due to the same factors affecting shrub-steppe and grasslands, with the most important of these being agricultural conversion, altered fire regimes, overgrazing, and exotic plant invasions. All of these factors are believed to be responsible for significant reductions in wildlife species such as the Ferruginous Hawk, which are highly dependent on functional western juniper.

Desired Functional Condition/Key Environmental Correlates: As described in Section 3.4.2, the desired functional conditions or key environmental correlates for functional western juniper habitat are:

- isolated, mature juniper trees with a density > one per square mile
- native perennial grasses and other low shrub cover between 6-24 inches to support ground squirrels and jackrabbits, which are major prey of Ferruginous Hawks
- mature, short (< 33 ft. in height) juniper for Ferruginous Hawk nesting trees

Overview of Objectives: The objectives for western juniper forest are prioritized in a way that is consistent with the Council's Fish and Wildlife Program strategy of "Build from Strength". Specifically, Biological Objective 1 aims to protect the most ecologically significant habitat first – mature juniper trees or stands in shrub-steppe and grassland habitats. Although the amount of mature juniper that needs increased protection is not currently known, it is suspected to be small. Biological Objective 2 seeks to expand management efforts to enhance up to 50% of mature juniper woodland habitat in the subbasin in ways that increase the likelihood of sustaining healthy populations of the Ferruginous Hawk, its prey, and other obligate species.

Biological Objective 1: Increase the protected status of all mature juniper associated with shrub-steppe and grassland habitats in the subbasin with no or low level protection to medium or high level protection by 2020.
Objective Priority: 1

> **Strategy 1:** Protect isolated mature juniper trees and stands of mature juniper in shrub-steppe and grassland habitats on private land to the desired level with cooperative agreements, conservation easements, and/or fee title acquisition, where appropriate. ***Strategy Priority:*** 1
>
> **Strategy 2:** Work with public land managers who have isolated mature juniper trees and stands in shrub-steppe and grassland habitats under their jurisdiction to ensure that all of it is administratively or legislatively protected to the desired level. ***Strategy Priority:*** 2
>
> **Justification:** This objective cannot be quantified until the completion of General Objective 1 because it is not known how much mature juniper habitat is associated with shrub-steppe and grassland in the subbasin and how much of it is

currently protected. Confidence in IBIS data on current distribution of this juniper type is low because of the inability to map patch sizes less than 250 acres. Data are not available from Kagan et al. (2000) either, because they were unable to use satellite imagery to map current mature juniper habitat. However, Kagan et al. (2000) report an estimate that irrigated agriculture has led to clearing 50-75% of these juniper stands. Some of the last substantial patches occur on the Boardman Bombing Range and in western canyons of the subbasin. Thus, all mature juniper associated with shrub-steppe is targeted for protection because 1) it is believed to be rare and 2) it provides habitat characteristics preferred by the Ferruginous Hawk and other obligate juniper species. This objective is of the highest priority for juniper habitat because is assures protection of the last remaining mature juniper occurring in shrub-steppe habitat in the subbasin. Strategy 1 is of a higher priority than Strategy 2 because most remaining mature juniper on shrub-steppe is believed to be on private lands.

Biological Objective 2: Enhance 50% of degraded juniper habitat in the Umatilla/Willow subbasin by 2020. Enhancement, guided by the completion of General Objective 1, will target tracts that 1) are currently at high or medium level protection, 2) improve mature juniper associated with shrub-steppe, 3) protect large and contiguous tracts, 4) increase habitat connectivity, and/or 5) add to existing protected areas. ***Objective Priority:*** 2

Strategy 1: Use fire management tools (e.g., prescribed burns) and silvicultural practices that lead to functional habitat for the Ferruginous Hawk, their prey, and other obligate species. ***Strategy Priority:*** 1

Strategy 2: Fund and coordinate weed control efforts on private and public lands. ***Strategy Priority:*** 1

Strategy 3: Modify livestock grazing practices, as necessary, to prevent damage of existing mature juniper and decrease spread of exotic weeds. ***Strategy Priority:*** 1

Strategy 4: Ensure that natural ecological processes, such as fire, that are necessary for a functional habitat for the Ferruginous Hawk, its prey, and other obligate species are allowed to proceed. ***Strategy Priority:*** 1

Strategy 5: In conjunction with Strategies 1-4, educate the public about the ecological importance of mature juniper habitat to increase local support of enhancement projects. ***Strategy Priority:*** 1

Justification: A target of 25% was selected given the limited knowledge of the amount and condition of juniper habitat in the subbasin. Confidence in the estimate of 36,495 acres of juniper woodland in the subbasin is fairly low; subbasin planners believe the amount may be significantly less. Improving habitat on up to 9,000 acres by 2020 is possible with adequate funding. Strategies are of equal priority because the severity of limiting factors is believed to vary from stand to stand.

SHRUB-STEPPE

Limiting Factors: Although the area of shrub-steppe habitat in the Umatilla/Willow subbasin appears to have more than doubled since c. 1850 (see Table x; Figure x), the quality of this habitat is believed to have declined significantly (see Section 3.4.2). Major factors affecting both low and higher elevation shrub-steppe habitat in the Umatilla/Willow subbasin are agricultural conversion (including the conversion of CRP lands back into croplands), exotic plant invasion, alteration of fire regimes, purposeful seeding of non-native grasses, and livestock grazing (see Section 3.5.2). These factors result in habitat loss, fragmentation, and degradation. Historically, the single largest factor responsible for shrub-steppe habitat loss in the Umatilla/Willow subbasin is conversion to agriculture. Remaining shrub-steppe habitat continues to be threatened by agricultural conversion, but of even greater concern is the proliferation of exotic weeds. Cheatgrass is especially problematic, as described in Section 3.1.1.9, because it increases the frequency and severity of range fires, which can lead to the replacement of sagebrush, bitterbrush, and other native shrubs with cheatgrass. The invasion of exotic plants is facilitated by the loss of cryptogamic crusts resulting from soil disturbances associated with tillage and inappropriate livestock grazing practices. Non-native animal species, including nest competitors (e.g., European Starlings, House Sparrow), nest parasites (e.g., Brown Headed Cowbirds), and domestic predators (e.g., cats, dogs) also negatively affect obligate species in this habitat. The effects of non-native species are magnified by habitat fragmentation. Additionally, shrub-steppe habitats in proximity to agricultural, recreational, and residential areas may be subject to high levels of human disturbance. All of these factors are believed to be responsible for significant reductions in shrub-steppe obligate species, such as the Sage Sparrow.

Desired Functional Conditions/Critical Environmental Correlates: Characterizing very specific critical environmental correlates that apply to all shrub-steppe habitat is difficult because shrub-steppe habitats are highly variable with respect to structure and plant species composition, both of which are strongly influenced by site conditions (e.g., hydrology, soil, topography). Sound management will take into account site conditions, and thus the inherent capability of the site to support a particular type of shrub-steppe community and wildlife assemblage. However, general ranges of critical environmental correlates that support the Sage Sparrow and most other obligate shrub species (e.g., Loggerhead Shrike, Burrowing Owl, Sage Thrasher) are as follows:

- late seral big sagebrush or bitterbrush with patches of tall shrubs with a height > 3 feet.
- mean sagebrush cover of 5-30%
- mean native herbaceous cover of 10-20% with <10% cover of non-native annual grass (e.g., cheatgrass) or forbs
- mean open ground cover, including bare ground and cryptogamic crusts > 20%
- mean native forb cover > 10%

Overview of Objectives: Shrub-steppe habitat in the Umatilla/Willow subbasin is found both at low-elevations, where it occurs primarily on silt and sand loam soils of the lower subbasin, and at higher-elevations, where it is primarily associated with the foothills of the Blue Mountains (see Section 3.2.4.2). Approximately 115,000 acres of shrub-steppe in the subbasin is believed to be low-elevation shrub-steppe (primarily big sagbrush steppe and bitterbrush). Five critical areas (Horn Butte-Willow Creek, Boardman Bombing Range, Boeing Lease Lands, the Umatilla Army Depot, and Juniper Canyon; see Section 3.2.4.2 for description) contain not only a large portion of this existing low-elevation shrub-steppe habitat in the subbasin (up to 50%), but also the largest and highest quality remnants of low-elevation shrub-steppe. In contrast, the estimated 124,480 acres of higher-elevation shrub-steppe (primarily rigid sage/sandberg bluegrass) are generally dispersed in small fragments, primarily on private land.

The objectives for shrub-steppe habitat take into account the differences between these two general types of shrub-steppe habitat that occur in the subbasin, and are prioritized in a way that is consistent with the Council's Fish and Wildlife Program strategy of "Build from Strength". Specifically, they are arranged so that they protect relatively healthy and productive habitats first, and then expand to adjacent habitats that have a high likelihood of sustaining healthy populations by reconnecting or improving habitat. Thus, the first three objectives relate to protecting, maintaining, and enhancing all of the low-elevation shrub-steppe in the five critical areas. The first objective relates to protecting all the estimated 50,000 acres of shrub-steppe habitat on the five critical sites, to prevent its further destruction. The second, equally important, objective is to enhance and maintain all ***high quality*** shrub-steppe habitat in those five areas. The third objective targets the enhancement of the remaining degraded shrub-steppe in the five critical areas. The fourth, fifth, and sixth objectives, all of equal priority, seek to protect and enhance a portion of the estimated shrub-steppe habitat outside of the five critical areas, and convert agricultural and CRP areas into shrub-steppe. Specifically, the fourth objective targets the protection of approximately 25% of the remaining shrub-steppe that occurs outside the five critical areas, and the fifth objective relates to enhancing about half of that area. The sixth objective aims to increase shrub-steppe habitat in the subbasin by approximately 10% through the conversion of low-yielding agricultural lands or CRP land. As with objectives for other habitats, an adaptive management approach will be used to modify shrub-steppe objectives and strategies as additional information is obtained through the completion of General Objective 1 and through research, monitoring, and evaluation.

Biological Objective 1: Ensure that all shrub-steppe habitat remaining within each of the five critical areas in the Umatilla/Willow subbasin is under medium or high level protection by 2010.
Objective Priority: 1

> **Strategy 1:** Work with public land and TNC managers in the five critical areas to ensure that all shrub-steppe habitat in these areas is administratively or legislatively protected at a medium or high level. ***Strategy Priority:*** 1

Strategy 2: Protect existing shrub-steppe habitat on private land in the five critical areas by using cooperative agreements, conservation easements, and/or fee title acquisition where appropriate. ***Strategy Priority:*** 2

Justification: All shrub-steppe habitat in these five critical areas is targeted for protection because, as described in Section 3.2.4.2, these areas have the majority of all high quality, low-elevation shrub-steppe habitat in the Umatilla/Willow subbasin. The total acreage of existing shrub-steppe habitat in these five areas will not be known until the completion of General Objective 1, but probably does not exceed 50,000 acres. Currently, less than 10% of this area is estimated to be under high or medium protection. This biological objective and Biological Objective 2 are the highest priority objectives for shrub-steppe habitat because they "build from strength" (i.e., efforts to improve wildlife habitat begin with protecting and supporting the most productive habitat first). Within Objective 1, Strategy 1 is a higher priority than Strategy 2 because most of the land in these five areas is controlled by government agencies or TNC (see Section 3.2.4.2).

Biological Objective 2: Maintain and/or enhance all high-quality shrub-steppe habitat remaining within each of the five critical areas in the Umatilla/Willow subbasin by 2010. ***Objective Priority:*** 1

Strategy 1: Implement measures that reduce non-native understory plants (primarily cheatgrass). ***Strategy Priority:*** 1

Strategy 2: Modify livestock grazing practices, as necessary, to reduce the negative impact on shrub-steppe vegetation and to decrease the spread of exotic weeds. ***Strategy Priority:*** 1

Strategy 3: Where ecologically appropriate, and where native perennial grasses and herbaceous plants are absent, seed shrub-steppe areas where competition from non-native annual grasses and plants has been addressed. ***Strategy Priority:*** 2

Strategy 4: Where ecologically appropriate, employ practices that encourage bare ground (e.g., dunes) in sand and silt-loam soils. ***Strategy Priority:*** 2

Justification: All high quality shrub-steppe habitat in these five critical areas is targeted for maintenance and/or enhancement because, as described in Section 3.2.4.2, these areas have the largest remaining high quality remnants of low-elevation shrub-steppe habitat in the Umatilla/Willow subbasin. The total acreage of existing high quality shrub-steppe habitat in these five areas will not be known until the completion of General Objective 1, but it is estimated to be relatively small. Even though a large portion of the shrub-steppe habitat in these five areas is owned or managed by the federal government, it continues to undergo permanent loss through degradation by exotic plants, altered fire regimes, and various other land practices (e.g., inappropriate livestock grazing practices). This objective focuses specific efforts toward maintaining and improving shrub-steppe within those critical sites by enhancing and maintaining the highest quality remaining "core" areas first. Thus, this biological objective and Biological Objective 1 are the highest priority objectives for shrub-steppe habitat because they "build from strength" (i.e., efforts to improve wildlife habitat begins with protecting and supporting the most productive habitat first). Of the strategies associated with Biological Objective 2, Strategies 1 and 2 are the highest priority because removal of exotic plants and protection from damaging livestock practices are necessary first steps before either Strategy 2 or Strategy 3 can be undertaken. Strategies 2 and 3 are ranked equally because either one or the other will be employed, depending on the ecological potential of the site.

Biological Objective 3: Enhance all existing degraded shrub-steppe habitats and re-establish shrub-steppe dominance on all ecologically appropriate sites within the five critical areas by 2020. Priority will be placed on sites that are adjacent to or provide connectivity with remaining high quality areas identified by the completion of General Objective 1.
Objective Priority: 2

Strategy 1: Implement measures that reduce non-native understory plants (primarily cheatgrass). ***Strategy Priority:*** 1

Strategy 2: Modify livestock grazing practices, as necessary, to reduce the negative impact on shrub-steppe vegetation and to decrease the spread of exotic weeds. ***Strategy Priority:*** 1

Strategy 3: For all degraded shrub-steppe habitat in the five critical areas, identify the ecological potential of each habitat microsite (e.g., basin big sage with bare soil or dune understory, Wyoming big sage with cryptogamic crust understory, bitterbrush with sand understory) and conduct specific practices to restore sites toward that potential.
Strategy Priority: 2

Strategy 4: In conjunction with Strategies 1-3, provide management, technical, and financial assistance to enhance degraded shrub-steppe habitat on privately owned lands adjacent to, or with potential connectivity to, shrub-steppe habitat in the five critical areas. ***Strategy Priority:*** 1

Justification: This biological objective focuses on working outward from protected and enhanced core areas to enhance, restore, and build connectivity in adjacent and nearby shrub-steppe habitats. Objective 3 is ranked second relative to Objectives 1 and 2, and should be undertaken once efforts have been made to protect, maintain, and enhance the highest quality remaining "core" areas, as outlined in Objectives 1 and 2. Of the strategies associated with Objective 3, Strategies 1 and 2 are of higher priority than Strategy 3 because removal of exotic plants and protection from damaging livestock practices are necessary first steps before conducting other practices that contribute to the restoration of sites. Strategy 4 is also of high priority because it essentially aims to encourage private landowners to engage in Strategies 1-3.

Biological Objective 4: Increase the protected status of up to 50,000 acres of shrub-steppe habitat outside of the five critical areas with little protection to medium or high level protection by 2020. Protection priorities, guided by the completion of General Objective 1 and existing information, will be based on the current habitat status and potential ecological function of the habitat with regard to focal and other obligate species and will target tracts that 1) are large (> 300 acre tracts, if possible) and contiguous, 2) have the potential to restore connectivity, and/or 3) add to existing protected areas.
Objective Priority: 3

Strategy 1: Protect existing shrub-steppe habitat on private land at the desired level by using cooperative agreements, conservation easements, and/or fee title acquisition where appropriate. ***Strategy Priority:*** 1

Strategy 2: Work with public land managers who have shrub-steppe habitat in their jurisdiction to ensure that all of it is administratively or legislatively protected at a medium or high level. ***Strategy Priority:*** 2

Justification: This objective (and Objectives 5 and 6) are ranked third for prioritization for shrub-steppe objectives. Shrub-steppe habitat existing outside of the five critical areas is highly fragmented, generally occurs in small patches, and is primarily in private ownership. Increasing protected status of 50,000 acres would benefit approximately 25% of the remaining shrub-steppe that occurs outside the five critical areas and would be a significant step towards protecting a biologically significant portion of the remaining shrub-steppe acreage. The target is believed to be feasible with adequate funding. Tracts greater than 300 acres are a high priority for protection because 300 acres is the minimum size capable of supporting the Sage Sparrow. Strategy 1 is a higher priority than Strategy 2 because most of shrub-steppe habitat outside the critical areas is privately owned.

Shrub-Steppe Biological Objective 5: Develop and implement specific management actions to maintain and/or enhance up to 25,000 acres of the shrub-steppe targeted for protection in Biological Objective 4 by 2020. Priority will be placed on sites that are adjacent to or provide connectivity with remaining high quality areas identified by the completion of General Objective 1.
Objective Priority: 3

Strategy 1: Implement measures that reduce non-native understory plants (primarily cheatgrass). ***Strategy Priority:*** 1

Strategy 2: Modify livestock grazing practices, as necessary, to reduce the negative impact on shrub-steppe vegetation and to decrease the spread of exotic weeds. ***Strategy Priority:*** 1

Strategy 3: Identify the ecological potential of each habitat microsite to be restored (e.g., basin big sage with bare soil or dune understory, Wyoming big sage with cryptogamic crust understory, bitterbrush with sand understory) and conduct specific practices to restore sites toward that potential. ***Strategy Priority:*** 2

Strategy 4: Provide private landowners with management, technical, and financial assistance as they work to enhance shrub-steppe habitat using Strategies 1-3. ***Strategy Priority:*** 1

Justification: Although managers realize that 25,000 acres is an ambitious goal, it was chosen because it would enhance approximately 50% of the shrub-steppe that is targeted for protection under Objective 4. Of the strategies associated with Objective 4, Strategies 1 and 2 are of a higher priority than Strategy 3 because removal of exotic plants and protection from damaging livestock practices are necessary first steps before conducting other practices that contribute to the restoration of sites. Strategy 4 is also of high priority because most of the land targeted for enhancement is privately owned, and thus, there is a great need to provide assistance to private landowners engaging in Strategies 1-3.

Shrub-Steppe Biological Objective 6: Convert 25,000 acres of low yielding agricultural land or CRP land into functional shrub-steppe habitat by 2020, resulting in an enhanced minimum parcel size of 300 acres, where possible.
Objective Priority: 3

Strategy 1: Encourage the conversion of lands currently enrolled in CRP into shrub-steppe habitat by providing technical assistance and financial incentives to actively manage those stands towards shrub-steppe habitats (e.g., by using prescribed burning, reseeding, light cultivation, herbicide treatments, managed grazing) within the conditions allowed under CRP contracts ***Strategy Priority:*** 1

Strategy 2: Use information produced through implementation of General Objective 1 to identify and prioritize agricultural lands that could increase shrub-steppe remnant size or establish connectivity between remnants of extant shrub-steppe land, and work to 1) enroll them in conservation programs (such as CRP), 2) develop cooperative agreements, 3) implement conservation easements, and/or 4) acquire, where appropriate. ***Strategy Priority:*** 1

Strategy 3: Identify the ecological potential of habitat microsites to be converted (e.g., basin big sage with bare soil or dune understory, or Wyoming big sage with cryptogamic crust understory, or bitterbrush with sand understory) and conduct specific practices to restore sites toward that potential. ***Strategy Priority:*** 2

Strategy 4: Encourage Congress and the NRCS to alter CRP requirements in the following ways: 1) change CRP bid point allocations to enhance the enrollment acreages of lands that are adjacent to existing shrub-steppe or lands that would provide connectivity between remnants of extant shrub-steppe, 2) require that enrolled tracts that are either adjacent to extant shrub-steppe or that provide connectivity between remnants of shrub-steppe are converted to shrub-steppe habitat rather than grassland only, and 3) increase the duration of CRP contracts from 10 years to 20 years. ***Strategy Priority:*** 3

Justification: A total of 25,000 acres is targeted because this would increase the amount of shrub-steppe habitat in the subbasin by approximately 10%. This should make a significant contribution towards increasing the size of existing remnants and improving connectivity between remnants. However, this target will be refined following the completion of General Objective 1, which will provide much-needed information about the spatial distribution, ownership, and protection of existing shrub-steppe remnants that will inform opportunities to restore additional shrub-steppe habitat. A minimum of 300 acres is targeted because it is the minimum size capable of supporting the Sage Sparrow. Strategy 1 is of a high priority because it builds from strength by working to improve lands that are currently in a conservation program. Strategy 2 is also an equally high priority because it is a necessary step for implementing Strategy 3. Strategy 4 is the lowest priority because the chance of successfully implementing it may be low.

INTERIOR GRASSLAND

Limiting Factors: Approximately 75% of interior grasslands in the Umatilla/Willow subbasin have been lost since c. 1850 (see Table x; Figure x). As indicated in the assessment (see Section 3.5.2), major factors affecting grassland habitat in the Umatilla/Willow subbasin are agricultural conversion (including the conversion of CRP back into cropland), exotic weed invasion, purposeful seeding of non-native grasses, overgrazing, and human-altered fire regimes. These factors result in direct habitat loss, fragmentation, and degradation. The single largest factor in habitat loss is conversion to agriculture. The largest factor in habitat degradation is the proliferation of annual grasses and exotic weeds, such as cheatgrass and yellow starthistle, which either replace or radically alter native bunchgrass communities. This invasion of exotic plants is facilitated by the loss of cryptogamic crusts, resulting from soil disturbances associated with tillage and livestock grazing. Non-native animal species, including nest competitors (e.g., European Starlings, House Sparrow), nest parasites (e.g., Brown Headed Cowbirds), and domestic predators (e.g., cats, dogs) also impact native species productivity. The effects of non-native species are magnified by habitat fragmentation. Additionally, grassland habitats in proximity to agricultural and recreational areas may be subject to high levels of human disturbance. All of these factors are believed to be responsible for significant reductions in grassland obligate species, such as the Grasshopper Sparrow.

Desired Functional Conditions/ Key Environmental Correlates

<u>For Native Grasslands</u>

- native bunchgrass cover > 15% and comprising > 60% of total grassland cover
- tall bunchgrass (> 10 inches tall)
- native shrub cover < 10%

<u>For Non-Native and Agricultural Grasslands (e.g. CRP lands)</u>

- grass forb cover > 90%
- shrub cover < 10%
- variable grass heights (6-18 inches)

<u>Landscape Level</u>

- patch size > 100 acres or multiple small patches greater than 20 acres, within a mosaic of suitable grassland conditions

Overview of Objectives: The objectives for interior grassland habitat are prioritized in a way that is consistent with the Council's Fish and Wildlife Program strategy of "Build from Strength". Specifically, Biological Objectives 1 and 2 aim to protect and enhance 5-10% of the best grassland habitat in the subbasin. Objective 3 seeks to enhance roughly 50% of the subbasin's grasslands – those enrolled in CRP and other conservation programs. Finally, Objective 4 targets the conversion of 15,000 acres of non-native annual grassland or low yielding dryland agricultural land into functional grassland in ways that build from existing, good quality grassland and increase the likelihood of sustaining healthy populations of the Grasshopper Sparrow and other grassland obligate species.

Biological Objective 1: Increase the protected status of 20,000-40,000 acres of existing native grasslands with low or no protection into medium or high level protection by 2020. Protection, guided by the completion of General Objective 1, will be prioritized based on the current or potential ecological function of the habitat with regard to the Grasshopper Sparrow and other obligate grassland species and will target tracts that 1) are large (> 100 acres, if possible) and contiguous, 2) have the potential to restore connectivity, and/or 3) add to existing protected areas.
Objective Priority: 1

> **Strategy 1:** Protect functional grasslands on private lands at the desired level with cooperative agreements, conservation easements, and fee title acquisition, where appropriate. ***Strategy Priority:*** 1
>
> **Strategy 2:** Work with tribal and public land managers who have native or ecologically functional interior grassland under their jurisdiction to ensure that those grasslands are administratively or legally protected to the desired level.
> ***Strategy Priority:*** 2

Justification: The target range of 20,000-40,000 acres represents 5-10% of existing native grasslands and is believed to be an achievable target that would not compromise the economic welfare of the subbasin. This target will be refined through adaptive management based on research associated with General Objective 1. This biological objective and Biological Objective 2 are the highest priority objectives for interior grassland habitat because they "build from strength" (i.e., efforts to improve wildlife habitat begin with protecting and supporting the most productive habitat first). Within Objective 1, Strategy 1 is a higher priority than Strategy 2 because most of the land in grassland habitat is privately owned (see Section 3.2.4.2).

Biological Objective 2: Maintain or enhance the 20,000-40,000 acres of grassland habitat targeted for protection in Objective 1 by 2020.
Objective Priority: 1

Strategy 1: Support the full funding and implementation of integrated weed management plans in the subbasin. ***Strategy Priority:*** 1

Strategy 2: Modify livestock grazing practices, as necessary, to reduce negative impacts on grassland vegetation and to decrease the spread of exotic weeds. ***Strategy Priority:*** 1

Strategy 3: Reestablish native plant communities where practical and cost effective. ***Strategy Priority:*** 2

Strategy 4: In conjunction with Strategies 1-3, aid private landowners in maintaining and enhancing grassland with management, technical, and financial assistance. ***Strategy Priority:*** 1

Justification: This objective would enhance all of the high quality grasslands protected under Objective 1. Of the strategies associated with Objective 2, Strategies 1 and 2 are of a higher priority than Strategy 3 because removal of exotic plants and protection from damaging livestock practices are necessary first steps before conducting other practices that contribute to the improvement of ecological function. However, Strategy 3 will be an important step in places where exotic vegetation is prevalent; if native vegetation is not planted after exotic vegetation is removed, exotic vegetation will quickly regenerate. Strategy 4 is also of high priority because most of the land targeted for enhancement is privately owned, and thus, there is a great need to provide assistance to private landowners engaging in Strategies 1-3.

Biological Objective 3: Enhance the ecological function and duration of benefits of over 200,000 acres of grassland habitat currently enrolled in CRP, EQIP, and WHIP in the subbasin as well as lands that will be enrolled in the future.
Objective Priority: 2

> **Strategy 1:** Provide additional technical assistance and financial incentives to actively manage grasslands enrolled in CRP, EQIP, or WHIP to meet goals beyond the basic requirements of those programs, so that ecological function with regard to the Grasshopper Sparrow and other obligate grassland species is maximized. ***Strategy Priority:*** 1
>
> **Strategy 2:** Work with the NRCS to improve the ecological function of agricultural lands enrolled in CRP by increasing the minimum conservation practice requirements so that they enhance ecological function with respect to the Grasshopper Sparrow and other obligate grassland species. ***Strategy Priority:*** 2
>
> **Strategy 3:** Work with the NRCS and other public policy makers to develop recommendations to the U.S. Congress that they modify the Farm Bill so that CRP contracts are extended from 10 to 20 years. ***Strategy Priority:*** 2
>
> **Justification:** Although this objective is prioritized second relative to Objectives 1 and 2 for grasslands, it takes advantage of a substantial opportunity for improving grassland condition in the subbasin by addressing over 50% of interior grassland in the subbasin, which are currently enrolled in CRP, EQIP, WHIP, and other conservation programs. Enrollment in these programs is expected to increase in the future. Thus, improving the ecological function and duration of benefits on these lands will have a positive impact on a majority of grasslands in the subbasin. Strategy 1 is the highest priority because the chance of successfully implementing it is believed to be higher than Strategies 2 and 3.

Biological Objective 4: Convert 15,000 acres of non-native annual grassland or low yielding dryland agricultural land not currently enrolled in conservation programs into native grasslands by 2020, and work to provide long-lasting protection to those converted grasslands. Conversion of tracts that 1) are large (> 100 acres, if possible) and contiguous, 2) have the potential to restore connectivity, and/or 3) add to existing protected areas will be the highest priority.
Objective Priority: 3

> **Strategy 1:** Use information produced through implementation of General Objective 1 to identify and prioritize agricultural lands that could increase existing grassland remnants or establish connectivity between grassland remnants, and work to 1) enroll them in conservation programs (such as CRP, WHIP, or EQIP), 2) develop cooperative agreements, 3) implement conservation easements, and/or 4) acquire, where appropriate. ***Strategy Priority:*** 1

Strategy 2: Work with the NRCS to alter the CRP bid point allocation to reflect ecological need as assessed in the habitat mapping conducted in General Objective 1. This would increase the likelihood that habitat identified as ecologically significant in the subbasin would be enrolled into CRP, and would enhance the size, distribution and connectivity of ecologically functional parcels. . ***Strategy Priority:*** 2

Justification: A total of 15,000 acres is targeted because this would increase the amount of grassland habitat in the subbasin by approximately 5%. Although this is a relatively small addition, it should make a significant contribution by targeting lands that could increase the size of existing high quality remnants and improving connectivity between these remnants. However, this target will be refined following the completion of General Objective 1, which will provide much-needed information about the spatial distribution, ownership, and protection of existing grasslands that will inform opportunities to restore additional grassland habitat. A minimum of 300 acres is targeted because it is the minimum size capable of supporting the Grasshopper Sparrow. Strategy 1 is of a higher priority than Strategy 2 because the chance of successfully implementing it is believed to be higher.

HERBACEOUS WETLANDS

Limiting Factors: As discussed in Section 3.4.2, existing information on herbaceous wetlands in the subbasin is limited. However, evidence suggests that most herbaceous wetlands in the subbasin have been destroyed or degraded (see Section 3.2.4). As indicated in the assessment (see Section 3.5.2), major factors affecting herbaceous wetlands in the Umatilla/Willow subbasin are habitat conversion and draining, lowering of ground water level, separation of floodplain from the stream channel due to dikes and levees, exotic plant and animal invasions, and livestock grazing. The limiting factors have led to the decline of herbaceous wetland obligate species, such as the Columbia spotted frog.

Desired Functional Conditions/ Key Environmental Correlates:
As described in Section 3.4.2, the desired functional conditions or key environmental correlates for functional herbaceous wetlands are:

- Abundant aquatic vegetation dominated by herbaceous species such as grasses, sedges, rushes and emergent vegetation
- Clear, slow-moving or ponded perennial surface waters
- Relatively exposed, shallow-water (< 24 inches)
- Deep silt or muck substrate
- Small mammal burrows
- Undercut banks and spring heads

Overview of Objectives: The objectives for herbaceous wetland habitat are prioritized in a way that is consistent with the Council's Fish and Wildlife Program strategy of "Build from Strength". Specifically, Biological Objectives 1 and 2 aim to protect and enhance all of the very limited amount of this habitat in the subbasin. Objective 3 seeks to roughly double the total amount of herbaceous wetland in the subbasin by 2020 to increase the likelihood of sustaining healthy populations of the Columbia spotted frog and other obligate species.

Biological Objective 1: Ensure that all existing herbaceous wetlands in the Umatilla/Willow subbasin are protected by 2010 at a medium or high level, to the extent possible. Protection, guided by the completion of General Objective 1, will be prioritized based on the current or potential ecological function of the habitat with regard to the Columbia spotted frog and other obligate species.

> **Strategy 1:** Work with private landowners to protect existing naturally-occurring herbaceous wetlands on private land with cooperative agreements, conservation easements, and/or fee title acquisition. In addition, promote the use of existing federal and state incentive programs (e.g., WRP) to protect herbaceous wetlands. ***Strategy Priority:*** 1
>
> **Strategy 2:** Work with tribal and public land managers who have naturally occurring herbaceous wetlands under their jurisdiction to ensure they are administratively or legislatively protected to the desired level. ***Strategy Priority:*** 2
>
> **Strategy 3:** In conjunction with Strategies 1 and 2, educate private landowners and the general public about the ecological importance of herbaceous wetlands and existing regulations that protect wetlands. ***Strategy Priority:*** 1
>
> **Justification:** All herbaceous wetlands are targeted for protection in this relatively short-term objective because, as discussed in Section 3.2.4.2, only 4,670 acres are estimated to exist in the Umatilla/Willow subbasin. Despite the fact that federal, state, and county regulations are aimed at limiting the destruction of wetlands (see Section 4.2), less than 15% of the subbasin's herbaceous wetland habitat is currently classified as being in medium or high level protected status. Thus, all herbaceous wetland habitat is targeted for protection by 2010 because it is rare and supports obligate wildlife species such as the Columbia spotted frog. Objectives 1 and 2 are of equally high priority because together they protect and enhance all remaining herbaceous wetland habitat in the subbasin. Within Objective 1, Strategy 1 is of higher priority than Strategy 2 because most existing herbaceous wetland habitat is believed to occur on private lands.

Biological Objective 2: Enhance and/or maintain all existing herbaceous wetlands in the subbasin by 2015. Enhancement and maintenance will be guided by the completion of General Objective 1, and will target tracts that 1) are large and contiguous, 2) have the potential to restore connectivity, and/or 3) add to existing protected areas.
Objective Priority: 1

Strategy 1: Restore natural hydrologic function where it has been disturbed by agricultural or developmental activities. ***Strategy Priority:*** 1

Strategy 2: Develop and implement techniques to reduce or eliminate bullfrogs. ***Strategy Priority:*** 1

Strategy 3: Reduce exotic plant species encroachment into remaining wetlands. ***Strategy Priority:*** 1

Strategy 4: Apply techniques to mimic natural disturbance regimes necessary to maintain native wetland vegetation and function. ***Strategy Priority:*** 1

Strategy 5: Enhance degraded, naturally-occurring wetland habitat on public or private land using moist soil techniques to establish permanent open-water refuge with a minimum water level as habitat for Columbia spotted frogs. ***Strategy Priority:*** 1

Justification: Because of its rarity and importance in the subbasin, all herbaceous wetland habitat is targeted for maintenance and/or enhancement by 2015. All strategies are of equal priority because all are considered to be necessary in addressing limiting factors for herbaceous wetlands and individual sites may vary with regard to which limiting factor is most problematic.

Biological Objective 3: Convert or create 5,000 acres of additional herbaceous wetland habitat in the subbasin by 2020.
Objective Priority: 2

Strategy 1: Restore wetland habitat in areas identified by the implementation of General Objective 1 as formerly having naturally-occurring wetland habitat. Restored wetlands would be created either through joint management projects with private and public landowners on their properties or through the enhancement of properties acquired as habitat mitigation areas in the subbasin. ***Strategy Priority:*** 1

Strategy 2: Create new wetland habitat in association with or connected to extant naturally-occurring wetlands in the subbasin. New wetlands would be created either through joint management projects with private and public landowners on their properties or through the enhancement of properties acquired as habitat mitigation areas in the subbasin. ***Strategy Priority:*** 2

Strategy 3: In conjunction with Strategies 1 and 2, work with federal agencies to implement wetland conservation and development programs such as the USDA's "Wetland Reserve Program" or USFWS's "Partners for Wildlife Program" in areas prioritized for restoration in the subbasin. ***Strategy Priority:*** 1

Justification: A target of 5,000 acres is selected because this would roughly double the amount of herbaceous wetland in the subbasin. As more data are generated from the completion of General Objective 1 and other research, this target may be modified. This objective is of a lower priority than Objectives 1 and 2 because it does not protect or enhance existing herbaceous wetlands but seeks to add new habitat. Strategy 1 is of higher priority than Strategy 2 because restoring former wetlands is a higher priority than creating new ones, all other factors being equal. Strategy 3 is also of high importance because it should aid in implementing Strategies 1 and 2.

RIPARIAN WETLANDS

Limiting Factors: As discussed in Section 3.4.2, between 86-99% of the historically-occurring riparian habitat in the subbasin is believed to have been destroyed. Although this habitat type makes up a small portion of the total area of the subbasin, it is disproportionately important in terms of providing valuable habitat for a multitude of wildlife species. As indicated in the assessment (see Section 3.5.2), major factors affecting riparian wetlands in the Umatilla/Willow subbasin are agricultural and urban development, exotic weed invasion, timber harvest, livestock grazing, transportation corridors, hydropower, and recreational activities. Hydropower, agricultural, urban, and transportation corridor development have led to habitat loss through conversion and channelization, have resulted in the separation of the floodplain from the stream, and have contributed to the degradation and fragmentation of remaining riparian habitat. Most of the extensive cottonwood galleries once found in riparian wetlands of the subbasin have been harvested. Existing riparian wetlands also continue to be degraded by exotic plant invasions and livestock grazing. These factors are believed to have negatively impacted species dependent on functional riparian areas, including the Great Blue Heron, the Yellow Warbler, and the American beaver.

Desired Functional Conditions/ Key Environmental Correlates
As described in Section 3.4.2, the desired functional conditions or key environmental correlates for riparian wetlands are:

- 40-60% tree canopy closure of cottonwood or other hardwood species
- multi-structure/age tree canopy (including trees 6 inches dbh and mature/decadent trees)
- woody tree groves > 1 acre and within 800 feet of water, where applicable
- vegetation within 328 feet of shoreline
- 40-80% native shrub cover, with more than 50% of shrub species being hydrophilic
- multi-structured shrub canopy > 3 ft tall

Overview of Objectives: Many of the objectives and strategies associated with the aquatic management plan that are aimed at improving riparian conditions will also benefit terrestrial wildlife. Thus, the terrestrial management plan focuses particularly on objectives and strategies for riparian habitat needs associated with wildlife that may not be addressed in the aquatic plan. The objectives for riparian wetland habitat are prioritized in a way that is consistent with the Council's Fish and Wildlife Program strategy of "Build from Strength". Specifically, Biological Objectives 1 and 2 aim to protect and enhance all of the very limited amount of this habitat in the subbasin. Objective 3 seeks to roughly double the total amount of functional riparian habitat in the subbasin by 2020 to increase the likelihood of sustaining healthy populations of the Great Blue Heron, Yellow Warbler, American beaver, and other obligate species.

Biological Objective 1: Ensure that all existing riparian wetlands in the Umatilla/Willow subbasin are protected at a medium or high level by 2010, with the following wetlands receiving the highest priority (listed in order of importance): 1) riparian areas with mature hardwood trees, especially cottonwoods, 2) areas with the highest ecological function with regard to the focal and obligate species, and 3) riparian areas adjacent to high priority river reaches, as identified through EDT modeling. Prioritization will be guided by the completion of General Objective 1 and EDT modeling, and will also target tracts that 1) are large and contiguous, 2) have the potential to restore connectivity, and/or 3) add to existing protected areas.
Objective Priority: 1

> **Strategy 1:** Protect riparian wetlands on private lands with cooperative agreements, conservation easements, and/or fee title acquisition. In addition, promote the use of existing federal and state incentive programs (e.g., CREP, EQIP, WRP, WHIP) to protect riparian areas. ***Strategy Priority:*** 1
>
> **Strategy 2:** Work with public land managers who have riparian wetlands under their jurisdiction to ensure that those wetlands are administratively or legally protected at the desired level. ***Strategy Priority:*** 2
>
> **Justification:** All existing riparian wetlands are targeted for protection in this relatively short-term objective because, as discussed in Section 3.2.4.2, only approximately 1,440 acres are estimated to exist in the Umatilla/Willow subbasin. Despite the fact that federal, state, and county regulations are aimed at limiting the destruction of wetlands (see Section 4.2), less than 1% of the subbasin's riparian wetlands are currently classified as being in medium or high level protected status. Thus, all riparian wetland habitat is targeted for protection by 2010 because it is rare, and supports a wide variety of wildlife species, including riparian obligate species such as the Great Blue Heron, the Yellow Warbler, and the American beaver. Objectives 1 and 2 are of equally high priority because together they protect and enhance all remaining riparian wetland habitat in the subbasin. Within Objective 1, Strategy 1 is of higher priority than Strategy 2 because most existing riparian wetlands are believed to occur on private lands.

Biological Objective 2: Enhance and/or maintain all existing riparian wetlands in the subbasin. Riparian wetlands receiving the highest priority (listed in order of importance) are those: 1) with mature hardwood trees, especially cottonwoods, 2) with the highest ecological function with regard to the focal and obligate species, and 3) adjacent to high priority river reaches, as identified through EDT modeling. Prioritization will be guided by the completion of General Objective 1 and EDT modeling, and will also target tracts that 1) are large and contiguous, 2) have the potential to restore connectivity, and/or 3) add to existing protected areas.
Objective Priority: 1

Strategy 1: Where necessary, re-establish natural riverine dynamics and floodplain/riverine interactions necessary for the establishment and maintenance of naturally-regenerating and functioning cottonwood galleries and/or other riparian vegetation. ***Strategy Priority:*** 1

Strategy 2: Protect existing mature cottonwoods and other hardwood trees from herbivory by native wildlife (e.g., beavers), as necessary. ***Strategy Priority:*** 1

Strategy 3: Where necessary, reduce exotic plant cover. ***Strategy Priority:*** 1

Strategy 4: Where necessary, modify livestock grazing practices that negatively impact riparian wetlands. ***Strategy Priority:*** 1

Strategy 5: Where necessary, plant native hydrophilic vegetation in areas where progress towards Strategies 1-4 is sufficient to allow native plants to survive.
Strategy Priority: 2

Justification: Because of its rarity and importance in the subbasin, all riparian wetland habitat is targeted for maintenance and/or enhancement by 2015. Strategies 1-4 are of equal priority because all are considered to be necessary in addressing limiting factors for riparian wetlands and individual sites may vary with regard to which limiting factor is most problematic. Strategy 5 is of lower priority than Strategies 1-4 only because Strategy 5 can only succeed if efforts towards Strategies 1-4 have been sufficient to allow native plants to survive. However, the importance of Strategy 5 cannot be underestimated; as described in Section 3.1.1.9, the problem of exotic weeds in riparian areas in the subbasin is widespread and severe. If native riparian vegetation is not planted in places where exotic vegetation has been removed, exotic vegetation will quickly regenerate. Thus, Strategy 5 will ensure that time and money devoted to the control of exotic vegetation in riparian areas are not wasted.

Objective 3: Convert or restore 1,500 acres of non-functioning riparian area into ecologically functional riparian habitat. Prioritization will be guided by the completion of General Objective 1 and EDT modeling, and will also target tracts that have the potential to restore connectivity, and/or add to existing high quality areas.

Objective Priority: 2

Strategy 1: Where necessary, re-establish natural riverine dynamics and floodplain/riverine interactions necessary for the establishment and maintenance of naturally-regenerating and functioning cottonwood galleries and other riparian vegetation. ***Strategy Priority:*** 1

Strategy 2: Where necessary, reduce exotic plant cover. ***Strategy Priority:*** 1

Strategy 3: Where necessary, modify livestock grazing practices that negatively impact riparian wetlands. ***Strategy Priority:*** 1

Strategy 4: Where necessary, plant native vegetation in areas where progress towards Strategies 1-3 is sufficient to allow native plants to survive. ***Strategy Priority:*** 2

Strategy 5: In conjunction with Strategies 1-4, work with federal agencies to implement wetland conservation and development programs such as the USDA's "Wetland Reserve Program" or USFWS's "Partners for Wildlife Program" in areas prioritized for restoration in the subbasin. ***Strategy Priority:*** 1

Justification: A target of 1,500 acres is selected because this would roughly double the amount of functional riparian habitat in the subbasin. As more data are generated from the completion of General Objective 1 and other research, this target may be modified. This objective is of a lower priority than Objectives 1 and 2 because it does not protect or enhance existing riparian wetlands but seeks to add new habitat. Strategies 1-3 are of equal priority because all are considered to be necessary in addressing limiting factors for riparian habitats and individual sites may vary with regard to which limiting factor is most problematic. Strategy 4 is of lower priority than Strategies 1-3 only because Strategy 4 can only succeed if efforts towards Strategies 1-3 have been sufficient to allow native plants to survive. However, implementing Strategy 4 is integral to ensuring that time and money devoted to the control of exotic vegetation in riparian areas are not wasted. Strategy 5 is also of high importance because it should aid in implementing Strategies 1-4.

5.5 Consistency with CWA and ESA Requirements

In the Umatilla/Willow subbasin, the federal Clean Water Act is implemented largely through the State's preparation of water quality standards, Total Maximum Daily Loads (TMDLs), and the TMDL implementation processes of designated management agencies. The ODEQ has identified streams throughout the subbasin that are water-quality limited for a variety of factors. Two of these -- sediment load and water temperature – are the most pervasive limiting factors to steelhead and salmon identified in this subbasin plan. Thus, there is a great congruence between the needs of the subbasin as outlined by the

TMDL and the needs of the focal species as outlined in this plan. Managers will be working closely with ODEQ staff to coordinate efforts to address both TMDL needs and fishery needs.

The plan is consistent with ESA in that the primary criteria for listing a focal species was its ESA status. Thus, the two threatened fish species in the subbasin, bull trout and summer steelhead, are given high priority for habitat restoration.

5.6 Research Monitoring and Evaluation

The assessment and EDT modeling exercises described in this plan depict the Umatilla Subbasin as a complex ecosystem with many interconnected components. The explanation of spatial and temporal variability of these components is the focus of UMEP; an informal network of fish and wildlife projects, including state, federal, tribal, and academic institutions, that operate at a variety of scales. The task is complicated because most projects operate at a single species or species assemblage scale, whereas spatial and temporal variability operate at the ecosystem, subbasin, and sub-watershed scales. The purpose of this section is to outline a holistic approach to ecosystem-based Research, Monitoring, and Evaluation (RM&E) that will facilitate adaptive restoration of Umatilla fish and wildlife.

The process used to develop fish and wildlife assessments and management plan objectives and strategies was based on the need for a landscape level holistic approach to protecting the full range of biological diversity at the Province scale. Attention was focused on the size and condition of core habitat/geographic areas at a subbasin scale, maintaining physical connections between core areas, and providing buffer zones surrounding core areas to ameliorate impacts from incompatible land uses. As most fish and wildlife populations extend beyond subbasin or other political boundaries, this “conservation network” must contain habitat of sufficient extent, quality, and connectivity to ensure long-term viability of obligate/focal fish and wildlife species. Subbasin planners recognized the need for large-scale planning that would lead to effective and efficient conservation and restoration of fish and wildlife resources.

Similarly, working hypotheses for focal habitat types and focal species were developed based on factors the environmental factors that affect them. Working hypotheses are statements that assist subbasin planners and their communities to clearly articulate a quantifiable program based on the most productive restoration actions in a given habitat type or geographic area. The basis for the hypothesis is the proximate or ultimate factors affecting habitats; i.e. the limiting factors. The relationship subbasin planners attempted to address in this process is one between management objectives, management strategies, and recommended (desired future) habitat conditions necessary to meet habitat and/or fish and wildlife objectives and goals.

The relationship between habitats and populations, the biological response summarized in each working hypothesis, must be tested in terms of project implementation (the quantity of habitat restored and extent of its restoration), followed by monitoring and evaluation of the population response. Ultimately, adaptive management is used to respond to the outcomes of these "tests" of working hypotheses. Each test is used to revise models of the Umatilla system, redefine priorities for restoration, and update biological objectives. At the same time the impacts of natural stochasticity and determinism, continued anthropogenic disturbance, and supplementation/reintroduction must be accounted for. The assessment and inventory synthesis cycle is illustrated in Figure 10. Movement through the cycle is summarized below:

1. Document and compare historic and current conditions of focal habitats to determine the extent of change.
2. Review habitat needs of focal and other obligate fish and wildlife species/assemblages to assist in characterizing the "range" of recommended future conditions for focal habitats. Combine species habitat needs with desired ecological/habitat objectives to determine recommended future habitat conditions.
3. Determine the factors that affect habitat conditions and species (limiting factors) and compare to current and recommended future habitat conditions to establish needed future action/direction.
4. Develop strategies to address habitat "needs" and identify "road blocks" to obtaining biological goals.
5. Review strategies and compare to existing projects, programs, and regulatory statutes (Inventory) to determine the level at which existing inventory activities address or contribute towards amelioration of factors that affect habitat conditions and species assemblages.
6. Develop goals and objectives to address strategies that define the key components of the management plan.

Post subbasin planning algorithms (Research, Monitoring and Evaluation) are described in 7 through 9 below.

7. Projects are approved, based on management plan strategies, goals, and objectives, and implemented.
8. Habitat and species response to habitat changes are monitored at the project, geographic area, sub-watershed, and subbasin scale, and compared to anticipated results.
9. Adaptive management principles are applied as needed, which leads back to the "new" current conditions restarting the cycle.

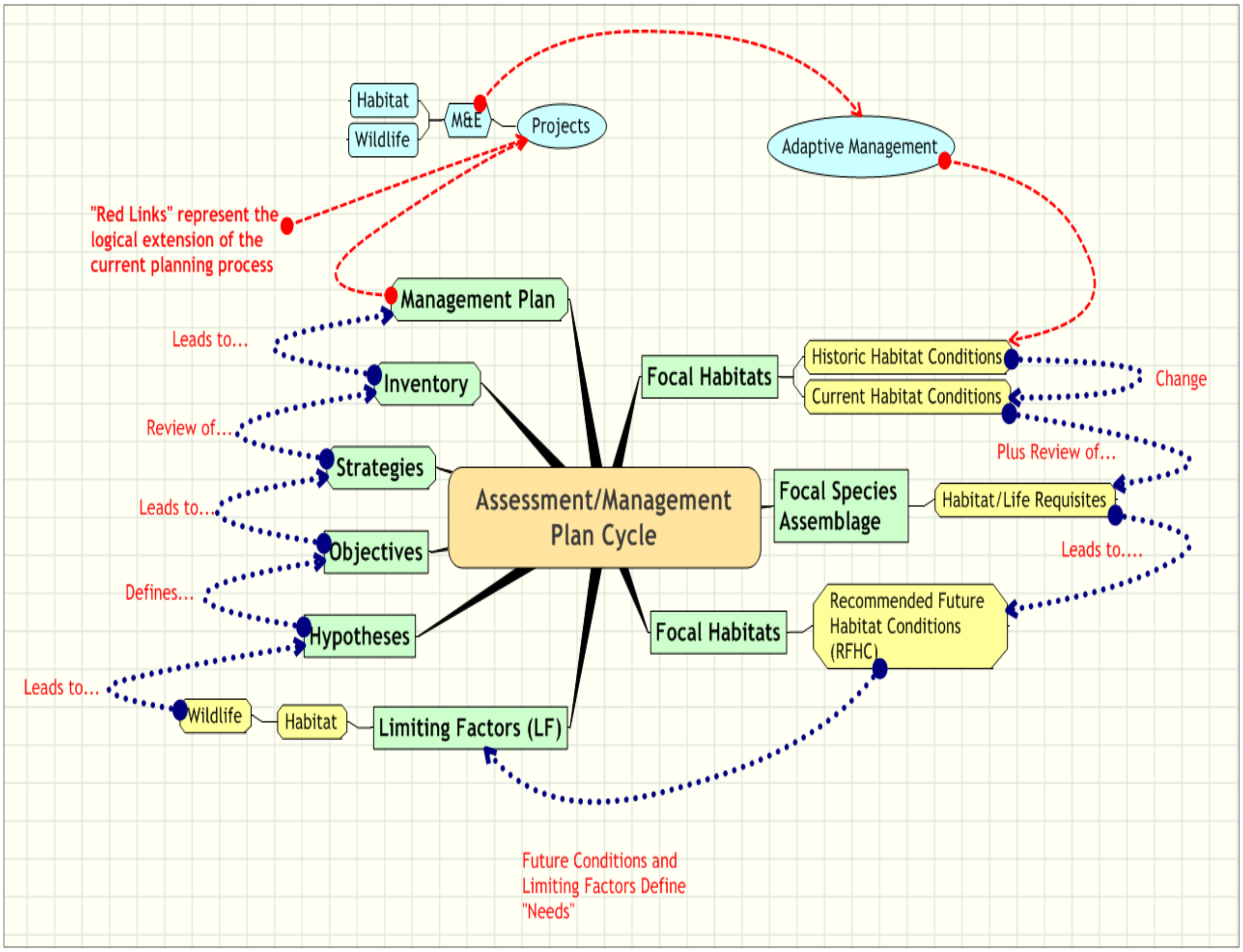

Figure 10. Adaptive Management Process

The Research Monitoring and Evaluation (RME) Plan lays out the framework that will allow for evaluation of the efficacy of implemented strategies in achieving corresponding focal habitat objectives for the subbasin, as per post subbasin planning algorithms 8 and 9. The RME plan emphasizes cooperative efforts among managers and stakeholders, and is designed to:

- evaluate success of management strategies, via monitoring of fish and wildlife species and their environments (The results of focal species monitoring and evaluation efforts are expected to function as potential performance measures to monitor and evaluate the results of implementing management strategies and actions on focal habitats).

- determine if management strategies undertaken are achieving recommended range of habitat management conditions, via monitoring and assessment of habitat conditions over time

- allow for evaluation of the assumptions and working hypotheses upon which the management plan is based, by quantifying the correlation between focal habitat management conditions and focal species population trends

- Finally, the Adaptive Management portion of this RM&E plan outlines a strategy that will allow managers to adjust and/or focus management activities within the subbasin, based upon monitoring and evaluation data. The feedback loop thus formed will facilitate development of future iterations of the subbasin management plan.

The RME plan, as presented, consists of a variety of quantitative elements, ranging from scientific population and habitat surveys, to simple enumeration of land use projects commented upon by cooperating agencies. Summaries of other ongoing RM&E activities in the basin that are not focused on subbasin planning under the NPCC Fish and Wildlife Program are appended for informational purposes.

Implementation of the Subbasin Plan is ultimately the responsibility of all managers and stakeholders who participated in its development. It is recommended that this group form an "Implementation Oversight Committee", to track and guide RM&E and reporting activities included in the plan.

The core monitoring activities will be conducted at three qualitative levels of intensity:

Tier 1 (trend or routine) monitoring obtains repeated measurements, usually representing a single spatial unit over a period of time, with a view to quantifying changes over time. Changes must be distinguished from background noise. In general, Tier 1 monitoring does not establish cause and effect relationships (i.e., is not research) and does not provide statistical inductive inferences to larger areas or time periods (ISRP 2003). On a programmatic scale (the NPPC Fish and Wildlife Program) we believe that HEP analysis (U.S. Fish and Wildlife Service 1980a) falls into this category. Particularly for projects that endeavor to mitigate a finite ledger of HUs associated with losses from a specific hydropower project, HEP adequately meets the monitoring needs, at a programmatic level, to ensure mitigation goals are being achieved. Consequently, HEP will remain an integral part of our overall monitoring strategy. GIS will be used to geo-reference Tier 1 data.

Tier 2 (statistical) monitoring provides statistical inferences to parameters in the study area as measured by certain data collection protocols (i.e., the methods in a report). These inferences apply to areas larger than the sampled sites and to time periods not studied. The inferences require both probabilistic selection of study sites and repeated visits over time. Individual Tier 1 proposals can support larger Tier 2 statistical monitoring projects such as the Oregon Plan by using the same field methods and methods to select study sites that contribute information to Tier 2 statistical monitoring. Most large projects should implement sampling designs that allow Tier 2 statistical monitoring or contribute data to statistical monitoring (ISRP, Comments on the Clearwater Plan, 2003). Most of the methods outlined in the M&E plan fall into this level of monitoring. A purposeful effort was made to select methods that are widely employed in field biology or to adopt appropriate monitoring protocols from national monitoring programs to maximize the utility of the data collected.

Tier 3 (research) monitoring is for those projects or groups of projects whose objectives include establishment of mechanistic links between management actions and salmon or other fish or wildlife population response. Tier 3 research monitoring requires the use of experimental designs incorporating “treatments” and “controls” randomly assigned to study sites (ISRP 2003). Individual Tier 1 and Tier 2 proposals can support Tier 3 research by adopting overlapping protocols.

5.6.1 Aquatic Research, Monitoring, and Evaluation Approach

Decades of management have made clear that the complex nature of restoration requires an RM&E approach that is both descriptive and explanatory in nature. It is essential but insufficient to say that a population is in decline when mechanistic solutions are required. The RM&E approach must document the rate of population change and the various factors that have influenced its trajectory, and it must be able to explain the interactions between causal factors and observed results. The approach UMEP has adopted has been under development for decades, and is being put to use in a management setting throughout the Columbia Basin. The ecosystem-based approach to management has received congressional review (EPAP 1999), and is heavily represented in both the federal RM&E standards that are currently under development (Jordan et al. 2003), and the Endangered Species Act RM&E strategies that are currently being implemented (USACOE et al. 2003). Collectively the EPAP report, federal Columbia Basin standards, and ESA strategies share at least 3 core scientific principles:

1. Due to the natural and anthropogenic complexity of the Umatilla and Columbia basins, only a ***systems monitoring*** approach can adequately inform fisheries management.
2. Due to the overwhelming importance of ecological interactions in the Umatilla and Columbia basins, only an ***ecosystem*** monitoring approach can adequately inform fisheries management.
3. Due to the complexity of research and monitoring tasks, only a ***regionally integrated*** ecosystem monitoring approach can adequately inform fisheries management.

Ecosystem-Based RM&E programs tend to be more complex to implement than traditional single species programs, but they are exponentially more informative. They address the population-scale phenomena of traditional fisheries M&E programs, the cause-effect relationships developed from critical uncertainties research, and the ecological components of a restoration program. They require a more efficient and well structured monitoring and evaluation effort. The trade-off is that greater planning and scrutiny are required, but that more powerful results can be produced, and therefore managers can be better informed. The mathematical goal of the approach is to produce statistically sound estimates of all significant processes that govern production, including direct and indirect interactions between fish and their systems. To be effective the approach must address attributes at several scales (from (Link 2002, TWS 2002):

1. Single Species Metrics a. Abundance b. Distribution c. Habitat d. Growth Rates e. Length-Frequency Relationship f. Fecundity and Productivity g. Population Trajectories h. Genetics i. Harvest **2. Community Metrics** a. Diversity b. Multi-Species Interaction Rates c. Competitive Interaction Rates d. Natural Mortality	**3. Food Web Metrics** a. Food Web Structure b. Connectivity c. Food Chain Length d. Link Density e. Omnivory and Cannibalism f. Predator/Prey Ratios **4. Aggregate Metrics** a. Flux b. Ascendancy c. Capacity d. Efficiency e. Guild Composition f. Guild Production	**5. Systems Analysis Metrics** a. Exergy b. Emergy c. Ecosystem Production d. Ecosystem Mass e. Resilience f. Persistence g. Resistance h. Stability i. Free Energy j. Information Content

The achievement of ecosystem-based RM&E does not require that all aspects of the system be actively monitored in the field on a continual basis. On the contrary, the logistical objective of an ecosystem-based approach is to identify and monitor only the most important limiting factors that are currently affecting restoration; irrespective of their source or nature (Karr and Chu 1999). Many of these metrics can be derived from other monitoring programs, or can be assessed with regular monitoring activities. Other components must be assessed directly using novel monitoring techniques or short-term studies. The remaining metrics, especially the aggregate and systems metrics, can be addressed in the evaluation process and provide substantial information on the overall success of fisheries programs using common currencies. The key is to determine which performance measures explain the largest components of variance in production, and to carefully research or monitor these using an appropriate sampling, analysis, and evaluation design. The power of this ecosystem approach was demonstrated in the assessment and management planning process through the application of EDT. By adopting EDT as the simulation standard for the Umatilla, the set of physical, chemical, and biological monitoring requirements can be easily defined, as can the integrated ecosystem approach to sampling and analysis.

Ecosystem-Based Sampling Design

The co-managers have adopted an ecosystem approach to determining the information needs associated with the qualitative management objectives and quantitative desired future conditions outlined in the management plan. EDT defines a set of population, habitat, and ecological information needed to effectively quantify production and productivity throughout the subbasin. The RM&E plan includes a list of performance metrics that must be monitored, along with their spatial scale and sampling effort needed to meet EDT modeling requirements.

The development of a spatially explicit sampling design is essential due to the limiting factors that operate at a variety of spatial scales. The EDT management unit is the geographic area, whereas the population viability unit is the subbasin. Detecting habitat changes at the geographic area scale is relatively straightforward, whereas connecting habitat changes and the biological response (i.e. testing the working hypotheses) is another matter. The restoration of a geographic area's habitat conditions should, in theory, result in increased spawner and juvenile utilization, but not independently of the aggregate forcing functions acting at the subbasin scale. Increased redd densities, for example, may be indicative of better sediment characteristics or total spawner escapement. The resolution of these spatial complexities requires a complex sampling regime that operates at the geographic area, sub-watershed, and subbasin scales using regionally integrated techniques.

Several parallel efforts are underway to refine a tributary RM&E design that will provide sufficient statistical power to discriminate between habitat, hatchery, harvest and hydrological impacts by addressing these metrics in tandem with a number of confounding factors. The general approach has been thoroughly outlined and is currently adoptable because it is based on first principles and a large body of research. The sampling design recognizes the impacts of spatial and temporal hierarchies on statistical analysis, and provides for natural and anthropogenic observational and treatment-reference experiments (Hillman 2003, Jordan et al. 2003, USACOE et al. 2003, ISAB and ISRP 2004). The general approach is to:

- Conduct long-term monitoring and evaluation of habitat and environmental conditions at the reach or geographic area scale.
- Conduct effectiveness monitoring of habitat restoration actions at the reach and watershed scales.
- Conduct long-term monitoring of sub-population and ecological conditions of fishes at the reach or geographic area scale.
- Conduct long-term monitoring of population attributes at the subbasin scale.

Habitat and hatchery actions tend to be limited in spatial scope and intensity by political, fiscal, or land-owner restrictions that are not easily overcome. Detecting the benefits of these actions on the spatial or temporal scale of their implementation is therefore not usually possible. The complex and dynamic nature of fish communities, and the confounding factors of ecological, harvest, hydrological, and hatchery interactions can easily swamp management impacts in the absence of a proper monitoring design (Rose 2000). If met the general design requirements presented above will allow information collected at different spatial and temporal scales to be analyzed and evaluated at the watershed or subbasin scale. This presents a nearly direct link between management actions and population responses.

Reach Scale Sampling

A number of attributes show tremendous variance at the reach scale. In-stream and riparian conditions tend to vary across meters and kilometers, resulting in a patchwork of essential fish habitat. Individual fish from all life-stages respond to these surroundings, make choices, and experience the environment accordingly. This interface of environment, behavior, and ecology defines the spatial scale for monitoring spawner success, juvenile sub-populations, and their surroundings. These variables will be sampled using a modified Environmental Monitoring and Assessment Program (EMAP) approach. Sampling effort will be stratified throughout each watershed at the reach scale, and the results will be aggregated accordingly. Similarly the direct impacts of habitat restoration will be quantified at the reach scale, and the response of sub-populations to these micro-scale changes will be evaluated at an aggregated spatial scale (geographic areas or the subbasin as a whole).

Watershed or Geographic Area Scale Sampling

The subbasin plan provides a set of working hypotheses, via which the efficacy of various restoration actions can be tested using Tier 1 and Tier 2 sampling designs. The predicted treatments were described above as desired future conditions. The actual habitat, hatchery, and harvest treatments each watershed will receive during each five year observation period will depend in part on the achievement of certain social, fiscal, and political barriers that are outside the control of the RM&E program. However, the working hypotheses can still be tested at the watershed or geographic area scale because the hypotheses themselves can be quantitatively tailored to the actual treatment each system receives.

Reach-scale attributes will be aggregated to the watershed or geographic area scale. In addition a number of variables including land-use characteristics, temperature, hatchery releases, and discharge will be sampled at the watershed scale. Several juvenile sub-population metrics will be collected at the reach scale, but will actually be sampled at the aggregated watershed scale. Growth rates, survival, and ecological interactions are features where variance at the micro-scale might be misleading due to the movements of fish across a number of reaches. Therefore, although these metrics will be sampled during reach-scale abundance and distribution studies, the sampling regime will be designed around watershed-scale comparisons.

Subbasin Scale Sampling

Several population and environmental metrics will be sampled at the subbasin scale, including several population production criteria such as population growth, length-frequency distributions, and the like. As outlined in the research agenda, most Tier 3 research will be conducted or evaluated at the subbasin scale including the relative reproductive success of spawners, and the connectivity of populations. A number of other reach and watershed-scale metrics will be aggregated to the subbasin scale. This will allow population viability criteria to be evaluated for the entire Umatilla Subbasin, while evaluating contributing factors at the reach, geographic area, or watershed scale. In additional several environmental attributes, such as total discharge and flow regimes, will be monitored or aggregated to the subbasin scale. This level of monitoring will allow for regional comparisons of relative performance. This study design is empowered by the variety of treatments that the John Day, Walla Walla, and Grande Ronde Subbasins receive associated with the assortment of hatchery, habitat, and harvest programs that they host. By incorporating regional standards in reach, watershed, and subbasin scale sampling each spatial aggregate can be analyzed and evaluated comprehensively, and the results will be comparable throughout the Columbia Plateau.

Ecosystem-Based Analysis and Evaluation

The relationships between focal populations and the variables that limit production are complex, confounded by mortality and movement, and masked by error in the sampling process (Williams 1999). Even in the case of hatchery releases or flow enhancement where direct control is possible, the impacts of actions may be masked by natural variance in the system, and the causes of these patterns may not be readily apparent. For example, it would be foolish to analyze the productivity of hatchery reared ESA listed STS without including the impacts of resident fish on population structure (Currens and Schreck 1995, Kostow 2003) and natural mortality (Beamesderfer et al. 1996). Any number of similarly confounding multi-species relationships could be defined, and some were highlight in section.

The watershed concept has been used to successfully address these complexities in tributaries (Moring and Lantz 1975, Ringler and Hall 1975, Hall 1977, Beschta and Taylor 1988, Hicks et al. 1991, Stednick and Kern 1994, Nakamoto 1998, Tschaplinski 2000, Thompson and Lee 2002, Bilby et al. 2003, Regetz 2003). These studies suggest that by aggregating several performance metrics to the watershed scale it will be possible to analyze and evaluate the impacts of management in the face of natural and anthropogenic stochasticity.

Ecosystem-based analysis of the factors that impact production at the watershed scale is quite different from more traditional population-focused inferential analysis. If certain design criteria are met, ecosystem-based analysis and evaluation can be used to discern confounding factors from important forcing functions such as management actions (Carpenter and Kitchell 1993). The current conditions of the Umatilla Subbasin have been assessed with considerable detail, and substantial “pre-treatment” information has been compiled (Contor 2003, CTUIR and ODFW 2004). Therefore the system is suitable for ecosystem-based association analysis at the watershed scale.

Variability in natural and anthropogenic characteristics mean that small differences in the treatments each watershed receives can influence the detection of their impacts over short time periods (Rosenbaum 2002). The intent of extending the analysis and evaluation period to five years is to discern treatment impacts from natural and anthropogenic stochasticity. This analysis and evaluation approach provides a framework for concurrent Tier 1, 2, and 3 evaluation based on long-term monitoring, short-term experiments, and system simulations. This "polythetic" approach can provide answers where other linear approaches fail to do so (Kitchell et al. 1988), and requires several parallel but distinct analysis paradigms.

Associative Analysis

Association analysis is the process of determining whether or not two or more measures relate to each other in an observational, before/after, or treatment/control experiment. Traditional inferential statistics including ANOVAs, t-Tests, regression, and principle components analysis all utilize the associative paradigm. The general equations for associative analysis of any variable X are the probability functions;

Equation 1.

$$\mu = \sum x \bullet P(x)$$

Equation 2.

$$\sigma^2 = \sum [(x - \mu)^2 \bullet P(x)]$$

Equation 3.

$$\sigma = \sqrt{[\sum x^2 \bullet P(x)] - \mu^2}$$

where P is the probability of encountering any given value of x, is the mean of that probability function, is the variance, and ^{2} is its standard deviation. These general equations are the foundation of probabilistic and inferential statistics, and have general applicability in the assessment of any quantitative association. This holds true whether the association is between a probabilistic distribution and a category, as in an analysis of variance, or in the association between observed data and a best fit line, as in the sum of squares estimate.

Reach, watershed, and subbasin-scale measures will be analyzed using inferential statistics to determine patterns of strong inference such as correlation, cross-correlation, or independence. These patterns will be used to infer cause-effect relationships between management actions and confounding factors where these are statistically plausible.

Trend Analysis

The trend analysis paradigm shares some features with associative analysis with one critical difference. Trend analysis recognizes the linear nature of time series; that no point in time can ever being experienced again, and that no co-occurrences in time can be fully independent of each other. Changes over time can result from the interactions of associated variables, but can also stem from serial dependency, seasonality, and temporal stochasticity. There are two major foci of time series analysis; to identify the correlates of a variable represented by a series of observations, and to predict the future values of that variable. The management intent of trend analysis is to quantify the deterministic components that underlie ecological function against the back-drop of spurious relationships. Trend analysis is generally conducted as an autocorrelative function; the serial correlation coefficients and standard errors of temporal lags in covariates for variable x:

Equation 4

$x_t = \xi + \phi_1 * x_{(t-1)} + \phi_2 * x_{(t-2)} + \phi_3 * x_{(t-3)} + \ldots + \varepsilon$

Where:

ξ is a constant (intercept), and

ϕ_1, ϕ_2, ϕ_3 are the autoregressive model parameters

Watershed and subbasin-scale variables, including aggregated reach-scale variables, will be analyzed using trend analysis, as will all continuous functions such as those attained from fixed sampling stations. The stability, resilience, and resistance of populations to disturbance will be quantified. Detrending, filtering, transfer functions, and intervention analysis will be applied. For each spatial scale and set of performance metrics we will ask “Did the system change?”, and if so “What were the most statistically plausible factors?” In addition we will use autocorrelation to build potentially predictive models of change.

Geostatistical Analysis

Geostatistical analysis is used to assess the spatial variability of a variable or variables, and then to utilize that variability and co-variability as an estimator or predictor of a variable such as population density (Petitgas 2001). Geostatistical analysis recognizes the potential spatial co-variation of metrics that can be intended, confounding, or predictive. Changes across space can result from the spatial distribution of variables such as the extent of clustering, or it can result from underlying co-variation with habitat or among species. In a stream-network spatial variability can also result from contingency and dependency on up-stream or down-stream factors. Geostatistical analysis relies on the estimation of spatial means, called the zone mean, rather than the process mean used in inferential statistics. The mean (Z) is derived from

Equation 5

$$Z_v = \frac{1}{V}\int_V z(x)dx$$

for any variable x, and its covariate v. The calculation of the estimate and estimator variance is exponentially more complex, and depends on the realization of an expectation function, covariogram, and variogram. The use of these spatial means to develop geostatistical or geospatial estimates of random or deterministic functions is perhaps not more complex, but more complicated because the precise method (or kriging forma) depends on the realized variogram and covariogram functions. The reader is referred elsewhere for fascinating discussions regarding the kriging decision tree (Demyanov et al. 2001, Lloyd and Atkinson 2001) and the application of results (Rendu 1980, Warren 1998, Barbaras et al. 2001).

Habitat, population, and environmental variables will be analyzed to determine their spatial co-variation. The relationship between population and habitat metrics will be used to conduct a geostatistical expansion of fish observations throughout each watershed. This expansion will be used to generate geostatistical stock assessment estimates (Petitgas 2001). We will apply geostatistical analysis in parallel with associative and trend analysis to determine the spatial, temporal, and nominal co-variation of performance metrics, treatment actions, and confounding factors.

Structural Analysis

Structural analysis is used to assess the general response of systems to treatments and natural permutations. Structural analysis can be qualitative or quantitative depending on the scale of investigation. Species diversity, community structure, connectivity, and link density are all structural variables that describe the ordered or un-ordered set of components that make up a system. Structural analysis is quantitative and qualitative; categorical and continuous. There are no strict mathematical examinations of structure, but the assessment of species/guild, links/trophic level, percent omnivory, etc. are all useful. We will assess the structure of each Umatilla watershed, included supplemented watersheds, using diversity indices, food web diagrams, and indices of community structure. We will aggregate these performance metrics to the subbasin scale to analyze changes in the Umatilla Subbasin through time. We will apply structural analysis in parallel with associative, trend, and geostatistical analysis to infer relationships between and among structural performance metrics, treatment actions, and confounding factors.

Functional Analysis

Functional analysis is used to quantify the mass and energetic changes of complex systems. Functional analysis is principally quantitative in nature, and relies heavily on system simulations. Single species, community, food web, aggregate, and ecosystem metrics can all be addressed using functional analysis. At the individual scale ecological function is most often depicted as:

Equation 6

$$Consumption = \mathrm{Re}spiration + Waste + Growth$$

At the aggregate scale of communities, ecosystems, reaches, or watersheds, ecological function is best represented as:

Equation 7

$$\mathrm{Pr}oduction =$$
$$harvest + predation\_mortality + biomass\_accumulation + migration + other\_natural\_mortality$$

or the delay-difference version:

Equation 8

$$dB_i/dt = g_i \sum_j C_{ji} - \sum_j Cij + I_i - (M_i + F_i + e_i)B_i$$

Where the biomass (B) of pool i, equals the net growth efficiency (g), biomass immigration (I), non-predation mortality/metabolic rate (M), harvest mortality (F), and emigration (e) adjusting the biomass over time (C) for each species ji and ij interaction (Walters et al. 1999). That equation can be further expanded to represent life stages, and would need to be for salmonids.

Performance metrics such as the natural mortality of hatchery reared smolts, consumption rates of all fishes, and the aggregate energetic metrics can all be quantified using functional simulations. We will analyze the performance of the Umatilla Subbasin using a holistic model of fish and their system. We will develop estimates of the function of each watershed and the Umatilla Subbasin as a whole. We will generate estimates of several ecological parameters that will not be sample in-situ. We will apply functional analysis in parallel with associative, trend, geostatistical, and structural analysis to infer relationships between and among single species and aggregate metrics of the Umatilla.

Evaluation

The polythetic approach to analysis will provide a robust framework for evaluation. UMEP will address qualitative and quantitative RM&E objective using a suite of univariate and multivariate statistics and simulations. The impacts of management actions will be evaluated in the context of natural and out-of-basin factors. Progress towards each management objective will be evaluated in terms of the realization of management actions the system receives and the biological response observed.

5.6.2 Terrestrial Wildlife Research, Monitoring, and Evaluation Approach

Organization of the Draft RME Plan Methodologies (Appendix H) is as follows:

Existing Data Gaps and Research Needs

- Existing Data Gaps, as identified through the subbasin planning process, are listed in this section, because many will require effort above routine monitoring and evaluation to address.
- Research needs, with justification, are also listed. Detailed research project design is not presented, however, being beyond the scope of the current planning effort

Monitoring and Evaluation: Ecological Trend, Focal Habitats and Species Monitoring Methodology

- Ecological Trend Monitoring (Plant Community, Land Birds, Herpetofauna, Small Mammals)
- Focal habitat monitoring methodology, and Management Plan strategies addressed
- Focal species monitoring methodology, and Management Plan strategies addressed
- Other Research, Monitoring and Evaluation Efforts in the Subbasin including those from managed species plans.

EXISTING DATA GAPS AND RESEARCH NEEDS

In the course of subbasin plan development, a number of data gaps were identified. Some of these gaps will be filled as data is collected via the monitoring and evaluation process as the plan is implemented. Others will require formal research efforts to address. Data gaps and research needs identified during development of the subbasin plan are listed in Table 11.

As part of the adaptive management philosophy of subbasin planning, managers believe that additional research needs not yet identified will become apparent over time. These needs will be addressed in future subbasin plan iterations.

Table 11. Data Gaps and Research Needs, Umatilla/Willow Subbasin, as identified during subbasin planning.

RESEARCH NEEDS AND DATA GAPS	STRATEGY TO ADDRESS	AGENCY/ PERSONNE L
GENERAL		
Testing of assumption that focal habitats are functional if a focal species assemblage's recommended management conditions are achieved		Coordinated government & NGO effort
Testing of assumption that selected focal or other obligate species/assemblages adequately represent focal habitats		Coordinated government & NGO effort
Current, broad-scale, high quality habitat data including structural KEC data	Spatial data collection and GIS analysis	Coordinated government & NGO effort
Accurate habitat type maps are needed to improve assessment quality and support management strategies and actions, including, updated and fine resolution historic/current data, current CREP, WHIP program/field delineations and GIS products e.g., structural conditions and KEC ground-truthed maps	Coordinated, standardized monitoring efforts; Spatial data collection and GIS analysis	Subbasin managers
Refinement of recommended management conditions for all habitats	Research need; use for update to future subbasin plan iterations	Coordinated government & NGO effort.
Local population/distribution data for focal species	Species Monitoring, Spatial data collection, and GIS analysis	Subbasin managers
Evaluate the role of management treatments to maintain/improve habitat quality	Coordinated, standardized monitoring efforts	Subbasin managers
ADD ALL DATA GAPS AND RESEARCH NEEDS FROM ASSESSMENT HERE.		

MONITORING AND EVALUATION: ECOLOGICAL TREND, FOCAL HABITAT, AND SPECIES MONITORING METHODOLOGY

Recommended monitoring and evaluation strategies for each focal habitat type, including sampling and data analysis and storage, are derived from national standards established by Partners in Flight for avian species (Ralph et al, 1993, 1995) and habitat monitoring (Nott et al, 2003). In addition, protocols for specific vegetation monitoring/sampling methodologies are drawn from USDA Habitat Evaluation Procedure standards (USFWS 1980a and 1980b) and *Sampling Vegetation for Monitoring Plant Communities* (Johnson, C.G. Jr., USDA Forest Service, Area 3 – Malheur, Umatilla, and Wallowa-Whitman National Forests, May 1998).

A common thread in the monitoring strategies which follow is the establishment of permanent roadside and off-road census stations to monitor bird population and habitat changes (See Land Bird Monitoring Section Below), small mammal census to track abundance, diversity and trends (see Small Mammal Monitoring Section below), herptofauna census to track presence/absence and abundance (see Herptofauna Monitoring section below).

Wildlife managers will include statically rigorous sampling methods to establish links between habitat enhancement prescriptions, changes in habitat conditions and target wildlife population responses at the project level.

Specific methodology for selection of Project Level Monitoring and Evaluation sites within all focal habitat types follows a probabilistic (statistical) sampling procedure, allowing for statistical inferences to be made within the area of interest.

The monitoring program is established for protected and managed habitats to monitor focal species population and habitat changes and evaluate success of efforts. Project monitoring will key in on factors effecting focal habitat attributes as defined in the working hypotheses for each focal habitat and the recommended range of management conditions (KEC's) defined in the plan.

Sampling design includes locating permanent survey transects within focal habitats in protected and managed habitats using HEP protocols. HEP is a standardized habitat-analysis strategy developed by the U.S. Fish and Wildlife Service and used extensively within the Columbia Basin to plan and track terrestrial mitigation actions pursuant to the NPCC Fish and Wildlife Program. It uses a variety of Habitat Suitability Indices (HSI) for select wildlife species to evaluate the plant community as a whole (Anderson and Gutzwiller 1996). Sites are stratified by cover type, and starting points are established using a random number grid. Minimum length of a HEP transect is 600 ft, and patches of cover must be large enough to contain a minimum transect without extending past a 100 foot buffer inside the edge of the cover type.

In addition, establishment of permanent plant community, avian, small mammal and herptofauna monitoring sites within focal habitats both on and off protected and managed habitat areas will provide information on long-term viability of obligate/focal wildlife species. Structural habitat conditions will be monitored at avian monitoring sites every 5 years as per Habitat Structure Assessment protocol (Nott et al 2003).
Draft Focal Habitat and Species monitoring methodologies are contained in Appendix H.

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ACRONYMS

ARS	Agricultural Research Service (USDA)
BIA	Bureau of Indian Affairs
BLM	Bureau of Land Management
BOR	Bureau of Reclamation (USDI)
cfs	cubic feet per second
CCRP	Continuous Conservation Reserve Program (NRCS)
Council	Northwest Power and Conservation Council (previously Northwest Power Planning Council)
CREP	Conservation Reserve Enhancement Program (NRCS)
CRITFC	Columbia River Intertribal Fish Commission
CRP	Conservation Reserve Program (NRCS)
CSMEP	Collaborative System-wide Monitoring and Evaluation Project
CTUIR	Confederated Tribes of the Umatilla Indian Reservation
dbh	diameter at breast height
DBTRP	Draft Bull Trout Recovery Plan
EDT	Ecosystem Diagnosis and Treatment Model
EPA	Environmental Protection Agency
EQIP	Environmental Quality Incentives Program
ESA	Endangered Species Act
ESU	Evolutionarily Significant Unit
FSA	Farm Service Agency (USDA)
GA	Geographic Area (used in EDT)
GWMA	Groundwater Management Area
HEP	Habitat Evaluation Procedure
HUC	Hydrologic Unit Code (USGS)
IBIS	Interactive Biodiversity Information System (NWHI)
MCR	Middle Columbia River
NEPA	National Environmental Protection Act
NFWF	National Fish and Wildlife Foundation
NGO	non-governmental organization
NMFS	National Marine Fisheries Service (now NOAA Fisheries)
NOAA	National Oceanic and Atmospheric Administration
NRC	National Research Council
NRCS	Natural Resources Conservation Service (USDA)
NWHI	Northwest Habitat Institute
NWI	National Wetlands Inventory
ODA	Oregon Department of Agriculture
ODEQ	Oregon Department of Environmental Quality
ODF	Oregon Department of Forestry
ODFW	Oregon Department of Fish and Wildlife
ONHP	Oregon Natural Heritage Program
OSU	Oregon State University
OWEB	Oregon Watershed Enhancement Program
OWRD	Oregon Water Resources Department

PDO	Pacific Decadal Oscillation
PFC	Properly Functioning Condition
PIF	Partners in Flight
PNAMP	Pacific Northwest Aquatic Monitoring Partnership
QHA	Qualitative Habitat Assessment Model
RC&D	Resource Conservation and Development Council
RM	river mile
SAS	Smolt to adult survival
SWCD	Soil and Water Conservation District
TMDL	Total Maximum Daily Load
TMFD	Three Mile Falls Dam
TNC	The Nature Conservancy
TOAST	Technical Outreach and Assistance Team
USCOE	United States Army Corp of Engineers
USDA	United States Department of Agriculture
USDI	United States Department of the Interior
USFS	United States Forest Service (USDA)
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey (USDI)
WHIP	Wildlife Habitat Incentive Program
WQMP	Water Quality Management Plan
WSU	Washington State University
WRP	Wetland Reserve Program